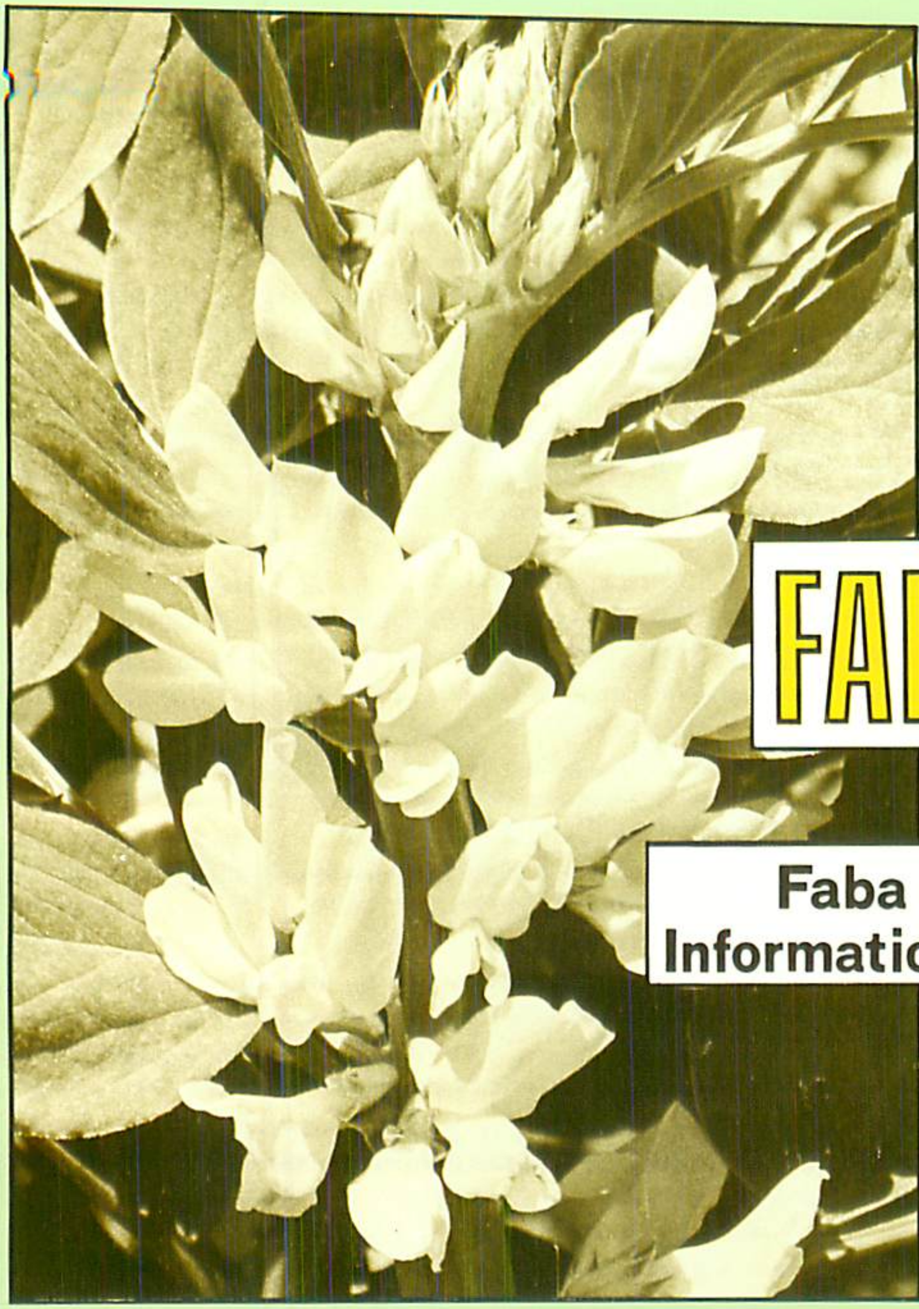

FABIS

Faba Bean Information Service

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No.22
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INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

(ICARDA)

ICARDA and CGIAR

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FABIS

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COVER PHOTO: A white-flowered faba bean accession at Tel Hadya, Aleppo, Syria.

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SHORT COMMUNICATIONS

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التربية والوراثة

Inheritance of Flower Color in Vicia faba L.

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Abstract

The inheritance of flower color in *Vicia faba* L. was studied. Four loci have been found to affect flower color. Two of these are complementary genes (w1 and w2) responsible for a white-flower. Brown and yellow colors were regulated by the Yf/yf locus, yellow being recessive. The locus Sdp/sdp controls the distribution of pigment, spotted being dominant to solid.

Introduction

The faba bean, *Vicia faba* L. is grown in many countries both for animal and human nutrition. This legume shows a great morphological variation, including that of flower and seed color, plant canopy and shapes of different organs (ICARDA 1986). The first and most comprehensive analyses of morphological characters in *V. faba* were performed by Erith (1930) and Sirks (1931). Sjodin (1971) completed these studies by locating some marker genes in their respective chromosomes using translocation lines. The present investigation was designed to complement the work of previous authors, through the study of new markers and produce lines carrying multiple variants for use in chromosome mapping.

Materials and Methods

The plant material consisted of some morphological mutants selected from our collection of *V. faba* in Cordoba. Table 1 shows the origin and flower colors of the lines under study.

The typical flower of *V. faba* is white with a dark brown to black spot on each wing petal and with dark brown or violet lines on the standard petal. The inheritance of the following mutations of flower color was studied: (i) white flower, with total absence of pigment on the petals; (ii) flowers with spots on the wings and yellow or violet lines on the standard petal; (iii) solid yellow flower; (iv) solid brown flower, both characterized by a diffuse pigmentation that completely or partially stains both the standard and the wing petals; (v) flowers with violet standard petal and brown wings; and (vi) flowers with pink or violet standard and yellow wing petals.

The different lines used were selfed for at least five generations. The parental plants and selfed progenies were grown in a glasshouse free of pollinators. In some cases, backcrosses were performed.

Results

Colored flower x White flower

One or two genes were responsible for flower color depending on the parent used. We named the two loci W1 and W2 respectively (**Table 1**). These loci are equivalent to those designated sp-a and sp-b by Sjodin (1971).

Data on flower color in the F_2 and backcross generations are presented in Table 2. They are in agreement with those reported by previous authors (Sirks 1931; Rowlands and Corner 1962; Sjodin 1971; Picard 1976, etc.). The F_1s always gave plants with colored flowers indicating that white flower is recessive to colored flowers. In all crosses the white parental VF15 segregated into a ratio of 3 colored-to 1 white-flowered plants showing that this line carries only one of the two recessive genes which give white flowered plants (**Table 2**). The backcross generation ratios are in agreement with these results.

On the other hand, the white parental VF14 produced two kinds of results. In some cases one gene was involved in producing pigmentation giving a 3:1

Table 1. Origin, flower color, and genotype of parental lines of faba bean.

Line	Origin and donor	Flower color	Genotype
VF44	UK (Bond, D.A.)	Brown spotted	Sdp Sdp Yf Yf W1 W1 W2 W2
VF34	South America (Duc, G.)	Brown spotted	Sdp Sdp Yf Yf W1 W1 W2 W2
VF106	Spain (Dpt. de Genetica, Cordoba)	Brown spotted	Sdp Sdp Yf Yf W1 W1 W2 W2
VF18	Spain (Dpt. de Genetica, Cordoba)	Brown spotted	Sdp Sdp Yf Yf W1 W1 W2 W2
VF6	Sweden (Sjodin, J.)	Brown spotted	Sdp Sdp Yf Yf W1 W1 W2 W2
VF23	Spain (Dpt. de Genetica, Cordoba)	Yellow spotted	Sdp Sdp yf yf W1 W1 W2 W2
VF101	Spain (Dpt. de Genetica, Cordoba)	Yellow spotted	Sdp Sdp yf yf W1 W1 W2 W2
VF84	Spain (Dpt. de Genetica, Cordoba)	Solid brown	sdp sdp Yf Yf W1 W1 W2 W2
VF76	Spain (Dpt. de Genetica, Cordoba)	Solid brown	sdp sdp Yf Yf W1 W1 W2 W2
VF59	Spain (Dpt. de Genetica, Cordoba)	Violet standard and brown wing petals	sdp sdp Yf Yf W1 W1 W2 W2
VF67	Spain (Dpt. de Genetica, Cordoba)	Violet standard and yellow wing petals	sdp sdp Yf Yf W1 W1 W2 W2
VF73	Spain (Dpt. de Genetica, Cordoba)	Violet standard and yellow wing petals	sdp sdp Yf Yf W1 W1 W2 W2
VF91	Spain (Dpt. de Genetica, Cordoba)	Solid yellow	sdp sdp yf yf W1 W1 W2 W2
VF15	Ethiopia	White	Sdp Sdp yf yf w1 w1 W2 W2
VF14	UK (Bond, D.A.)	White	sdp sdp Yf Yf w1 w1 w2 W2

segregation ratio in the F_2 generations (VF34 x VF14). However, in the other crosses (VF44 x VF14 and VF59 x VF 14), the F_2 segregated into 9 colored :7 white-flowered plants indicating a complementary gene interaction of the alleles controlling white flowers (**Table 2**). The backcross generations produced results consistent with these. The line VF14 is clearly segregating for w1 or w2.

Brown x Yellow pigmentation

The F_1 generations produced only plants with brown flowers, indicating that brown is dominant over yellow. The F_2 generations of all the crosses segregated into 3 brown to 1 yellow-flowered plants, showing monogenic inheritance. This segregation was confirmed by the backcrosses (**Table 3**). We propose the Yf/yf symbol for this locus (**Table 1**). However, Sjodin (1971) gave the dp-a symbol to this locus.

Spotted x Solid distribution of pigment

All the F_1 generations showed spotted flowers, indicating that spotted is dominant over solid. The F_2 generations of all the crosses segregated into 3 spotted to 1 solid-flowered plants, showing monogenic inheritance, which was confirmed by the backcrosses (**Table 4**). The symbol proposed for this locus is Sdp/sdp (**Table 1**). This locus is equivalent to that designated dp-b by Sjodin (1971).

Discussion

It is well known that at least two complementary genes are responsible in *V. faba* for white flower. These genes have been claimed to have pleiotropic effects over other genes for pigmentation. Thus, white-flowered plants lack anthocyanin, and show black stipule spots, reddening of the stem, and low tannin content in seed (Picard 1976). Nevertheless, other pigments such as green or grey seeds can be found on white-flowered plants.

The inheritance of the two colors (yellow and brown) and their distribution can be deduced from data in **Tables 2 and 3**. These data clearly indicate that only one gene controls the step from yellow to brown pigment synthesis, yellow being recessive. The same results were obtained in the crosses involving spotted and solid distribution of pigment, spotted being dominant over solid pigment.

When digenic segregation among Sdp and Yf loci was studied, F_1 was normal (brown spot on each wing petal). The F_2 generation segregated into a 218 normal (Sdp Yf): 64 yellow spotted (Sdp yf) : 61 solid brown (sdp Yf): 24 solid yellow (sdp yf). This segregation coincided with a 9:3:3:1 Mendelian ratio (X^2 = 3.67; 0.3 > P > 0.1).

The two white-flowered lines used in this study are genetically different not only for the two

Table 2. Observations on flower color in the F_2 and backcross generations in the crosses : colored x white-flowered faba bean plants.

Generation	No. of plants observed with flower			Expected ratio	X^2	P
	Colored	White	Total			
F_2						
VF44 x VF15	180	62	242	3:1	0.05	0.9 - 0.7
VF34 x VF15	90	29	119	3:1	0.02	> 0.9
VF59 x VF15	166	64	230	3:1	0.98	0.5 - 0.3
VF23 x VF15	139	47	186	3:1	0.11	0.9 - 0.7
VF84 x VF15	39	14	53	3:1	0.06	0.9 - 0.7
VF34 x VF14	93	22	115	3:1	2.12	0.3 - 0.1
VF44 x VF14	75	43	118	9:7	2.24	0.3 - 0.1
VF59 x VF14	102	66	168	9:7	1.36	0.3 - 0.1
Backcross						
(VF44 x VF15) x VF44	65					
(VF44 x VF15) x VF15	10	7	17	1:1	0.53	0.5 - 0.3
(VF59 x VF15) x VF59	15					
(VF59 x VF15) x VF15	25	26	51	1:1	0.02	0.9 - 0.9
(VF44 x VF14) x VF44	34					
(VF44 x VF14) x VF14	23	19	42	1:1	0.38	0.7 - 0.5
(VF59 x VF14) x VF59	57					
(VF59 x VF14) x VF14	22	24	46	1:1	0.09	0.9 - 0.7

Table 3. Observations on flower color in the F_2 and backcross generations in the crosses : brown x yellow -flowered faba bean plants.

Generation	No. of plants observed with flower			Expected ratio	X^2	P
	Brown	Yellow	Total			
F_2						
VF44 x VF15	130	50	180	3:1	0.74	0.5 - 0.3
VF59 x VF23	117	38	153	3:1	0.04	0.9 - 0.7
VF34 x VF15	65	25	90	3:1	0.37	0.7 - 0.5
VF106 x VF101	98	34	132	3:1	0.04	0.9 - 0.7
VF6 x VF67	34	7	41	3:1	0.98	0.5 - 0.3
VF84 x VF101	23	9	32	3:1	0.04	0.9 - 0.7
VF23 x VF14	42	14	56	3:1	0.00	> 0.9
VF34 x VF23	135	37	172	3:1	1.12	0.3 - 0.1
VF59 x VF15	121	45	166	3:1	0.39	0.7 - 0.5
Backcross						
(VF44 x VF15) x VF44	65					
(VF44 x VF15) x VF15	7	3	10	1:1	0.90	0.5 - 0.3
(VF59 x VF23) x VF59	65					
(VF59 x VF23) x VF23	18	24	42	1:1	0.86	0.5 - 0.3
(VF34 x VF15) x VF34	9					
(VF34 x VF23) x VF23	18	19	37	1:1	0.03	0.9 - 0.7
(VF59 x VF15) x VF59	15					
(VF59 x VF15) x VF15	11	14	25	1:1	0.39	0.7 - 0.5

complementary genes responsible for white flower (**Table 2**), but also for the loci controlling the brown and yellow pigments and their distribution on the flower. The F_1 plants of the crosses among colored and white-flowered plants (**Table 2**) had normal flowers except in some cases. The cross VF23 x VF15 gave an F_1 with yellow spots and the cross VF59 x VF14 gave flowers with violet standard and brown-winged petals. These results support that the white-flowered line VF15 carries the recessive allele for the yellow gene (**Table 3**) and the dominant allele for spotted distribution of pigment (**Table 4**). On the contrary, the white-flowered line VF14 carries the dominant allele for brown pigment (**Table 3**) and the recessive allele for solid distribution (**Table 4**).

This is confirmed by the colors that *V. faba* plants and pods can take after ripening. Brown flower plants produce dark-matured plants and pods, while yellow-flowered plants produce light-matured plants and pods. However this is independent of the expression of color genes in the flower. Thus, the white line VF15, which carries the yellow gene, has light-colored pods and plants at maturity, whereas VF14 which carries an allele for brown color produced dark pods and plants at maturity.

When studying brown or yellow vs. violet pigmentation the results are not conclusive. Some of the parental lines used in the crosses had violet standard and brown or yellow wing petals (**Table 1**). In the descendants of the crosses involving the lines VF59, VF67, and VF73, some plants with violet standard petals were present. The same was shown when lines carrying the alleles for brown and solid distribution (VF84, VF76, and VF14) were crossed.

When a plant with violet standard and yellow wing petals is crossed with a solid-yellow-flowered plant (VF73 x VF91) the F_1 plants showed solid yellow flowers. Whereas, in the F_2 generation, three plants had flowers with violet and yellow lines on the standard petal, and one plant had violet pigment on the wing petals. The remaining plants had flowers with a gradation of intensity varying from yellow to green pigmentation.

Sjodin (1971) found 29 mutants forming a series of multiple alleles of dp-a locus, including dark brown, violet, and solid yellow pigments. We think that the solid yellow phenotype is expressed when the two genes (Sdp and Yf) are in the double homozygotic recessive

Table 4. Observations on flower color distribution in the F_2 and backcross generations in the crosses : spotted x solid distribution of pigments in faba bean.

Generation	No. of plants observed with flower			Expected ratio	X^2	P
	Spotted	Solid	Total			
F_2						
VF59 x VF15	124	42	166	3:1	0.008	> 0.9
VF59 x VF23	121	32	153	3:1	1.36	0.3 - 0.1
VF59 x VF44	159	57	216	3:1	0.23	0.7 - 0.5
VF34 x VF14	70	23	93	3:1	0.004	> 0.9
VF18 x VF76	45	11	56	3:1	0.86	0.5 - 0.3
VF18 x VF84	30	12	42	3:1	0.28	0.7 - 0.5
VF84 x VF101	22	8	32	3:1	0.12	0.9 - 0.7
VF6 x VF67	30	11	41	3:1	0.07	0.9 - 0.7
VF44 x VF14	61	14	75	3:1	1.60	0.3 - 0.1
Backcross						
(VF59 x VF15) x VF59	15					
(VF59 x VF15) x VF15	8	7	15	1:1	0.07	0.9 - 0.7
(VF59 x VF23) x VF23	42					
(VF59 x VF23) x VF59	37	28	65	1:1	1.25	0.3 - 0.1
(VF59 x VF44) x VF44	57					
(VF59 x VF44) x VF59	12	16	28	1:1	0.57	0.5 - 0.3
(VF44 x VF14) x VF44	34					
(VF44 x VF14) x VF14	13	10	23	1:1	0.39	0.7 - 0.5

state and solid brown when sdp sdp Yf Yf genotype is present.

Violet color is produced by anthocyanins. Brown and yellow pigments are responsible for pink or violet-flowered plants. However, pink or violet pigmentation is always found in such plants at any stage of development. But, solid or spotted wing petal has never been found in them. The violet or pink pigment is probably the first step on the biosynthetic pathway of pigmentation. It is most likely that there are many factors controlling the expression of the violet pigment. However, a strong environmental influence is not expected. A continuous variation in coloration is the result of many genetic factors. In conclusion, the results of different crosses and also the lines of our study clearly show that pigmentation on wing and standard petals are independent.

Acknowledgment

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توريث لون الزهرة في الفول
Vicia faba L.

ملخص

درس توريث لون الزهرة في نباتات الفول Vicia faba L. وقد تبين وجود أربعة مواضع جينية (loci) تؤثر في لون الزهرة ، إثنان منها مورثات تكميلية (w1 و w2) تعطي أزهاراً بيضاء . أما اللونان البني والأصفر فيتحكم فيهما الموضع الجيني Yf/yf لأن اللون الأصفر متنحٍ . ويتحكم الموضع الجيني Sdp/sdp بتوزيع الصبغ النباتي ، حيث يسود اللون المنقط (المبرقش) على غير المنقط .

Influence of Flower Color on Seed Yield and Yield Components in Faba Bean

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Abstract

Observations were recorded for plant height, seed yield, number of tillers, number of pods/plant, seeds/pod, and 100-seed weight on the F_2 plants of two crosses namely WF x Dholi-8 and WF x WH-51, segregating for flower color. Plants with white flower significantly yielded lower than those with colored ones. This was accompanied by a significant reduction in the number of pods/plant, tillers/plant, and 100-seed weight. Exploitation of variability within white-flowered genotypes may improve the yielding ability of white-flowered faba bean.

Introduction

Tannins in faba bean, as in many other food legumes also, constitute an antinutritional factor. Therefore, tannin-free cultivars, which can be evolved through

Table 1. Expression of seed yield and yield components in white and colored flowered faba bean plants.

Cross/flower color	Character[1]					
	Plant height(cm)	Tillers/ plant	Pods/ plant	Seeds/ pod	100-seed weight (g)	Seed yield/ plant (g)
WF x Dholi-8						
White	125a	4.0a	33.9a	2.8	24.8A	23.5A
Black	134b	4.9b	42.6b	2.8	29.4B	32.9B
WF x VH 51						
White	143	3.6a	34.8A	2.8	23.2a	21.5A
Black	138	4.6b	48.2B	2.8	24.5b	30.0B

[1] Different letters show significant differences at the 5% (small letters) and 1% (capital letters) levels of probability.

breeding, are desirable. Absence of tannin in faba bean has been found to be associated with white flower color (Bond 1976; Picard 1976). This has created interest among faba bean breeders in involving white-flowered cultivars. The white flower trait may, however, be associated with certain undesirable traits. Norel (1985) reported 39% emergence in white-flowered faba bean lines as compared to 84% for the colored flowered ones. Presently, the yield of white-flowered genotypes is not as good as that of colored flowered cultivars (Cubero 1984; PBI 1985). The present study reports the expression of seed yield and some other metric traits of F_2 faba bean plants segregating for flower color.

Materials and Methods

Observations on individual F_2 plants segregating for flower color were recorded for plant height, number of tillers, number of pods, number of seeds/pod, 100-seed weight, and seed yield. Thirty five to forty plants in each group for each of the two crosses viz, WF x Dholi-8 and WF x VH-51 were observed. Means were compared by using the t-test.

Results and Discussion

Difference for seed yield/plant was highly significant between white and colored flowered plants in both the crosses (**Table 1**). The significantly low yield of white-flowered plants appeared to be a function of their significantly low 100-seed weight and smaller number of pods and tillers/plant, but not of seeds/pod. White-flowered plants were shorter in the cross WF x Dholi-8, but taller in the cross WF x VH-51, the difference being significant in the former cross. Because of the conflicting results in the two crosses, expression of plant height in the colored and white flowered plants needs to be further studied. A closer comparison, for yield and yield components, of the top ranking 5% plants in both groups showed even wider differences. Results of the present study suggest that a clear cut improvement has to be achieved in the yield components, particularly in the number of pods/plant, to increase the yield potential of white-flowered faba bean cultivars. For this, the variability within white-flowered genotypes needs to be exploited. Already, there are indications that improved white-flowered genotypes can yield up to 85% of the colored-flowered high yielding commercial variety. However, with continued efforts, this level can be further increased.

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تاثير لون الزهرة على الغلة البذرية ومكوناتها في الفول

سجلت قراءات على طول النبات ، والغلة البذرية ، وعدد الإشطاءات ، وعدد القرون/النبات ، وعدد البذور/ القرن ، ووزن المئة حبة على انعزالات نباتات الجيل الثاني لهجينين هما WF X WH - 51 و WF X Dholi - 8 بحسب لون الزهرة . وقد أعطت النباتات ذات الأزهار البيضاء غلة أقل معنويا من النباتات ذات الأزهار الملونة، وقد رافق ذلك انخفاض معنوى في عدد القرون/النبات ، وعدد الإشطاءات/النبات ، ووزن المئة حبة . إن استغلال التباين الموجود ضمن الطرز الوراثية ذات الأزهار البيضاء يمكن أن يحسّن الطاقة الإنتاجية لتلك الطرز .

Genetic Studies on Salt Tolerance in Faba Bean (Vicia faba L.)

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Abstract

The 5x5 diallel cross analysis was used to study the genetics of salt tolerance at germination in faba bean. The studies conducted under laboratory conditions revealed that additive and non-additive gene effects with a preponderance of additive gene effects govern the inheritance of salt tolerance at germination. Two parents, namely Somaly and Kobrosy, were reported as good general combiners for salt tolerance.

Introduction

Most of the crop plants are sensitive to salts at high concentrations (Epstein 1972). Since the tolerance of crop plants to salinity at germination and later growth stages has been reported to be of similar magnitude, the screening for salt tolerance should be possible at germination stage (Nieman and Shannon 1976).

In Egypt, faba bean (*Vicia faba* L.) is grown under areas which are canal irrigated and due to this the concentration of salts is increasing on the soil surface. Previous work on salt tolerance by Leon and Ayers (1951) has revealed varying response of different varieties of green beans to salt tolerance indicating thereby the presence of genetic differences among various genotypes. To make use of any such variation in faba bean genotypes for a breeding program, the present study was undertaken on the genetics of salt tolerance at germination stage.

Materials and Methods

A diallel cross set involving 5 parents namely Somaly (P1), Balady (P2), Kobrosy (P3), Long Equadore (P4), and Barnyard Exhibition (P5), and 10 possible crosses (F_1s) excluding reciprocals comprised the materials for the present study. Ten seeds of each of the parents and F_1s were grown in two petri dishes in triplicate, using a salt solution with electrical conductivity of approx 10 mmhos/cm prepared by using NaCl and $CaCl_2$ in equal proportion. The experiment was conducted at moderate temperature of 25°C. The germination percentage data was transformed using angular transformation and were analysed using Griffing (1956) method 2 model 1.

Results and Discussion

The analysis of variance for combining ability for germination percentage under salinity conditions is presented in **Table 1.** The mean square due to general combining ability (GCA) as well as specific combining ability (SCA) were significant and the magnitude of GCA was more. This showed that both additive and non-additive gene effects were important (with preponderance of additive gene effects) and were responsible for the inheritance of germination of faba bean seeds under salinity conditions.

The GCA effects of parents (**Table 2**) further revealed that two parents namely Somaly (P1) and Kobrosy (P3) are good general combiners for high germination percentage under saline conditions. It is sug-

Table 1. Analysis of variance for germination percent of seeds in a 5x5 diallel cross in faba bean.

Source	df	Mean squares
Genotypes	14	2207.5**
GCA	4	573.7**
SCA	10	286.0**

** Significant at $P < 0.01$.

Table 2. GCA and SCA effects for the arrays and cross combinations for germination rate in the 5x5 diallel cross in faba bean.

Array	P1	P2	P3	P4	P5
P1	(+11.40)**	-27.8**	-8.1	+8.3	+4.0
P2		(+0.23)	-10.3*	-6.5	+2.8
P3			(+6.02)*	-11.6**	-15.0**
P4				(-10.49)**	-11.2*
P5					(-7.16)**

SE (Gi-Gj) ± 7.85; SE (Sij -Sik) ± 19.2; SE (Sij -Skl) ± 17.5

*, ** Significant at $P < 0.05$ and $P < 0.01$, respectively.
The values in parentheses are GCA effects.

gested that these parents may be exploited further in hybrid breeding programs for improvement of land races for salinity tolerance.

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دارسات وراثية حول تحمل نباتات الفول
للملوحة (Vicia faba L.)

ملخص

استخدم تحليل متبادل (ثنائي الأليل أو النظير) لهجين 5 x 5 لدراسة وراثة مدى تحمل الفول للملوحة في مرحلة الإنبات . وقد كشفت الدراسات المنفذة تحت ظروف المختبر عن وجود تأثيرات للجينات ذات أثر متجمع وغير متجمع additive and non-additive gene effect، مع رجحان الاولى ، تتحكم في توريث صفة تحمل النبات للملوحة وهو في مرحلة الإنبات . وقد ذكر عن وجود أبوين ، هما الصومالي والقبرصي، يتمتعان جيدا بصفة التحمل للملوحة بشكل عام .

Some Important Phenological Correlations of Wollo Faba Bean (Vicia faba L.) Germplasm

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Abstract

In an endeavour to assemble a working population of Vicia faba L. for the improvement of grain yield and quality, collection of germplasm was done in six Wollo administrative regions in Nov and Dec 1981 under the auspices of the Ethiopian Plant Genetic Resources Center. During the field collection, seed color, seed size, and hilum color were recorded on samples. Observations on damage by pod borer, frost, chocolate spot, rust, and lodging were also recorded. In the subsequent evaluation of 60 accessions at Debre Ziet Research station, eight important phenological characters were evaluated besides the evaluation of yield. Highest variability was exhibited in plant height followed by number of flowers/plant, grain yield, and pods/plant. Plant height did not correlate with grain yield. Evaluation of 44 accessions for eight phenological traits at Bekoji Research Station showed that highest variability was in grain yield followed by plant height. Here plant height and days to flowering were correlated and had significant bearing on grain yield. Plants with 100 and 105 cm in height gave the best grain yield. Expression of variability in the yield components was better at Debre Zeit than at Bekoji.

Introduction

The highland plateau of Ethiopia is considered to be the secondary center of domestication of faba bean (Huffnagel 1961). The crop is widely distributed in the country with large genetic variability. This is an important crop for local consumption and for export, and yet no improved cultivar has been available to the farmer. However, several efforts have been made in the past to collect and evaluate the germplasm in Ethiopia (Westphal 1974; Toll 1980), but the informtion has been fragmentary and limited. For instance, Westphal (1974) in faba bean taxonomy studies from Wollo had only eight market samples.

Prior to 1977, there had hardly been any systematic collections and evaluations documented in the country. The present report on the evaluation of germplasm collection for faba bean from Wollo region aims to partly remedy this situation.

Materials and Methods

Following the procedure of Hawkes (1976), collections were made at a distance of 5-10 km and each sample was 0.5-1 kg in weight. Data were collected on elevation, topography and soil chracteristics of each site, nature of surrounding crops, duration of crop, and pests, diseases and biotic stress effects on the crop using the Plant Genetic Center of Ethiopia (PGRC/E) format. The majority of the collections were from farmers' fields. Samples from market were limited in number (3, 10, 11, and 1 samples each from Dissie-Zuria, Wore-Himenu, Borena, and Segno markets).

Agronomic evaluations were carried out by growing the samples at Debre Zeit and Bekoji which represent, the Moina-dega and the Dega zones respectively. The decision on whether a sample should be planted at Debre Zeit or at Bekoji was based on the elevation of the site where the sampling was done. Soil texture of Debre Zeit is silt loam whereas that of Bekoji is red clay. Each sample was sown in a plot of 4×1.6 m^2 at the seed rate of 200 kg/ha, and normal nursery management was adopted.

The crop was examined at least once a week. Diseases such as chocolate spot (*Botrytis fabae*) and rust (*Uromyces viciae fabae*) were recorded on a 0-5 scale. Flowering date was recorded when 95% of the plants in a given plot had at least one flower. Physiological maturity was recorded when the lower pods started blackening and the upper pods started yellowing. Plant height was also taken at this stage. Data on flowers/plant, pods/plant, and seeds/pod were based on five plants randomly selected from plots of harvestable rows. Harvesting was done when most of pods as well as the stem had completely turned black. Harvested plants were air dried in jute sacks for 3-5 days. The air-dried plants were threshed and seed weight was adjusted to 10% moisture. Data on grain yield and other agronomic traits were statistically analyzed.

Results

The six Wollo administrative regions from which collections were done are shown in **Fig. 1**, and some of their physiological features are in **Table 1**. The results of the evaluations at the Debre Zeit and Bekoji sites are presented in **Figs. 2-6**. Grain yield varied considerably between the two locations. The lowest yielding accession at Bekoji yielded four times higher than the highest yielders at Debre Zeit. At Bekoji, mean grain yield was 5200 kg/ha, whereas it was 2900 kg/ha at Debre Zeit (**Table 2**). This was mainly due to the unusually unfavorable environmental conditions at Debre Zeit caused by two heavy storms during the

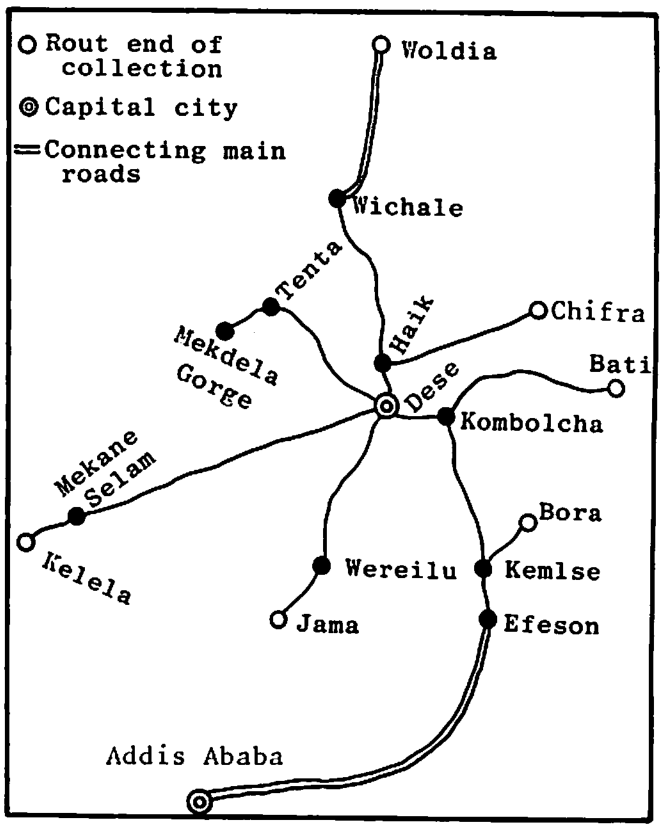

Fig. 1. Faba bean germplasm collection tour in Wollo.

Table 1. Some of the physiographic features of the six Wollo administrative regions from where the collection was done.

Administrative region	Elevation (m)		Temperature* (°C)	Rainfall* (mm)	Collection date	No. of samples	No. of sites
	Mean	Range					
Kalu	2062	1920-2260	15-20	300-600(75)	18/11/81-19/11/81	5	5
Wore-Ilu	2490	2300-3050	15-25	600-1000(125)	21/11/81-25/11/81	25	25
Borena	2511	2300-2740	10-15	800-1000(150)	26/11/81-28/11/81	24	12
Wore-Himenu	2794	2320-3110	10-15	600-800(150)	29/11/81-05/12/81	20	16
Ambasel	2326	1930-2650	15-20	600-800(125)	05/12/81-08/12/81	18	10
Dessie-Zuria	2390	1950-2690	15-20	800-1000(125)	09/12/81-11/12/81	17	12

* Adopted from National Atlas of Ethiopia Addis Ababa. Values in brackets are those of October to January.

Table 2. Maximum, minimum, and mean values for various characters and some statistical values for different accessions of Wollo Faba beans evaluated at Debre Zeit (sample size 60) and Bekoji (sample size 44) during the 1982/83 season.

Character	Site	Maximum	Minimum	Mean	95% C.I.	Coefficient of variability
Yield (kg/ha)	D. Zeit	65.0	4.0	2943	29.43+25.23	42.961
	Bekoji	87.2	17.4	5201	52.01+32.03	30.592
Days to flowering	D. Zeit	84.0	45.0	55.27	55.27+5.70	5.160
	Bekoji	70.0	54.0	63.70	63.70+0.04	7.049
Chocolate spot score*	D. Zeit	3.8	2.6	3.12	3.12+0.56	8.926
	Bekoji	3.0	1.0	2.40	2.40+1.08	22.532
Rust score*	D. Zeit	4.0	2.4	3.76	3.76+0.55	7.266
	Bekoji	3.0	1.0	2.70	2.70+1.03	19.936
Plant height (cm)	D. Zeit	195.0	110.0	145.67	145.67+38.38	13.173
	Bekoji	105.0	50.0	80.69	80.69+23.45	14.431
Flowers/plant	D. Zeit	87.0	5.0	63.53	63.53+27.86	21.928
	Bekoji					
Pods/plant	D. Zeit	50.0	3.0	19.12	19.12+19.88	48.792
	Bekoji	39.0	9.0	19.20	19.20+1.41	36.451
Seeds/pod	D. Zeit	4.0	1.0	1.90	1.90+1.20	31.698
	Bekoji	3.0	2.0	2.93	2.93+0.51	9.697
Stand	Bekoji	100.0	35.0	89.52	89.52+39.06	20.950

* Disease rating done on 0 - 5 rating scale.

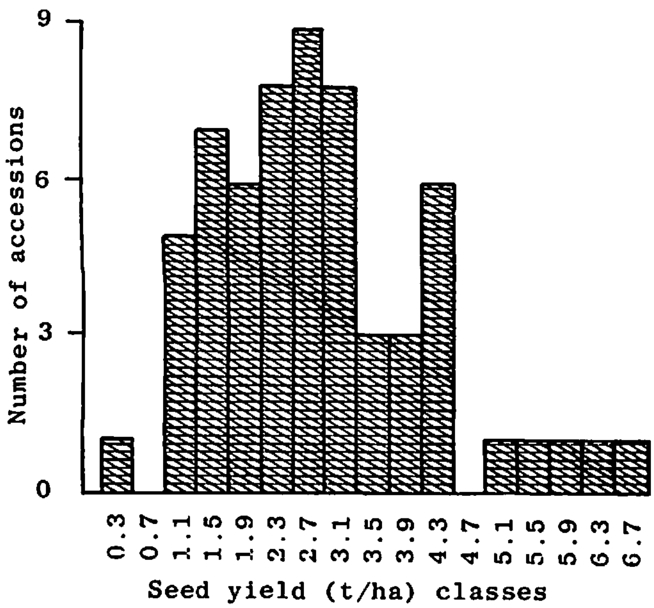

Fig. 2. Frequency distribution for grain yield of Wollo faba bean germplasm accessions grown at Debre Zeit during the 1982/83 season.

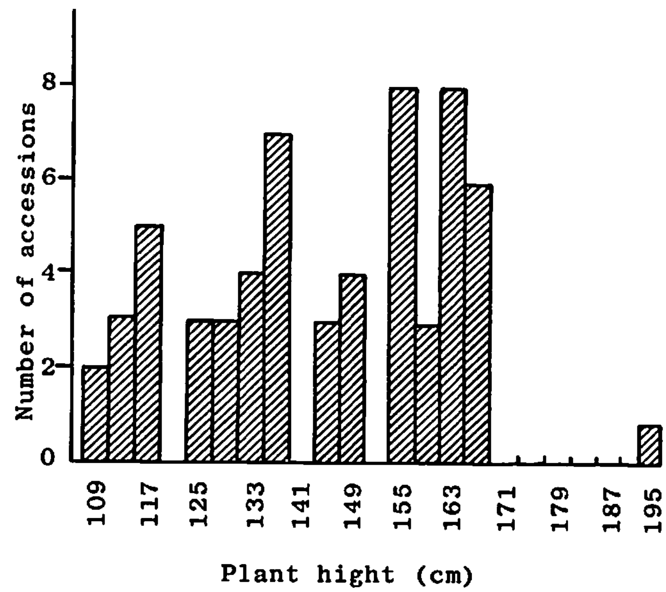

Fig. 4. Frequency distribution for plant height in Wollo faba bean germplasm accessions planted at Debre Zeit during the 1982/83 season.

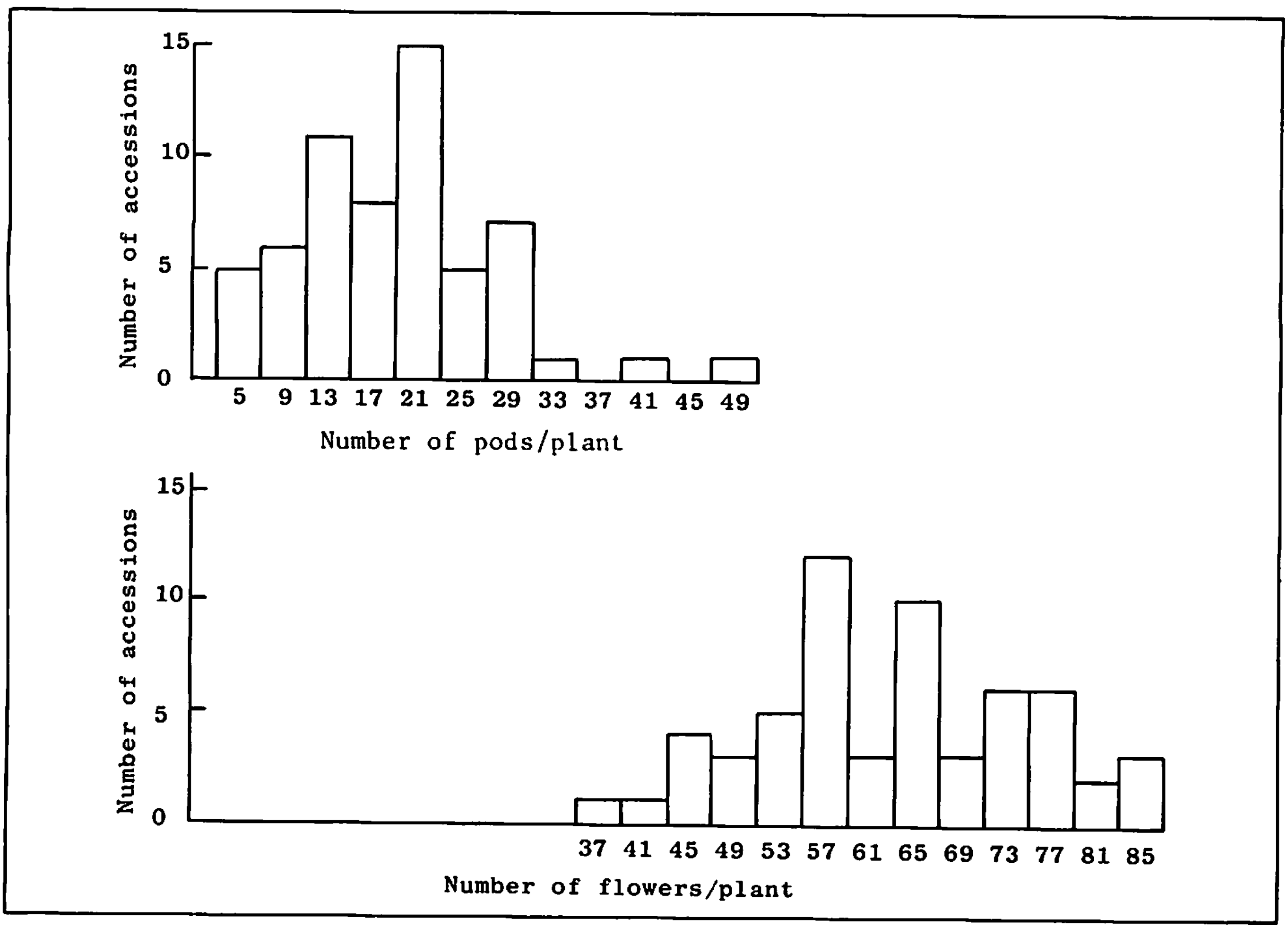

Fig. 3. Frequency distribution for number of flowers/plant and number of pods/plant in Wollo faba beans germplasm grown at Debre Zeit during the 1982/83 season.

growing season. The first caused excessive flower drop and lodging of plants. The second, which occurred during grain filling stage, prevented proper grain filling.

The average plant height was 140 cm at Debre Zeit with a range of 110-195 cm, whereas, it was 95 cm at Bekoji with a range of 50-105 cm (**Figs. 4** and **5**). In both sites, plant height did not show any significant effect on grain yield or number of pods/plant. The average number of pods/plant was higher at Debre Zeit than at Bekoji (**Figs. 3** and **5**). However, the average number of seeds/pod was lower at Debre Zeit than at Bekoji, 1.9 and 2.9, respectively (**Table 2**).

Table 2 shows that the coefficient of variability for grain yield, number of pods/plant, and number of seeds/pod were markedly higher at Debre Zeit than at Bekoji. This was expected partly due to variations in the soil between blocks of the nursery.

The simple correlation coefficients estimated among pairs of characters for 60 accessions evaluated at Debre Zeit and 44 at Bekoji are presented in **Tables 3** and **4**, respectively.

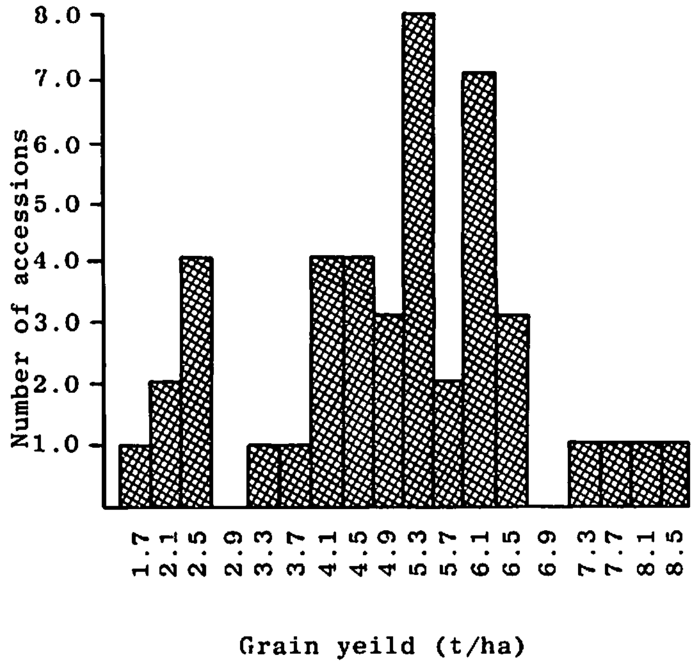

Fig. 6. Grain yield distribution pattern of 44 faba bean accessions from Wollo grown at Bekoji during the 1982/83 season.

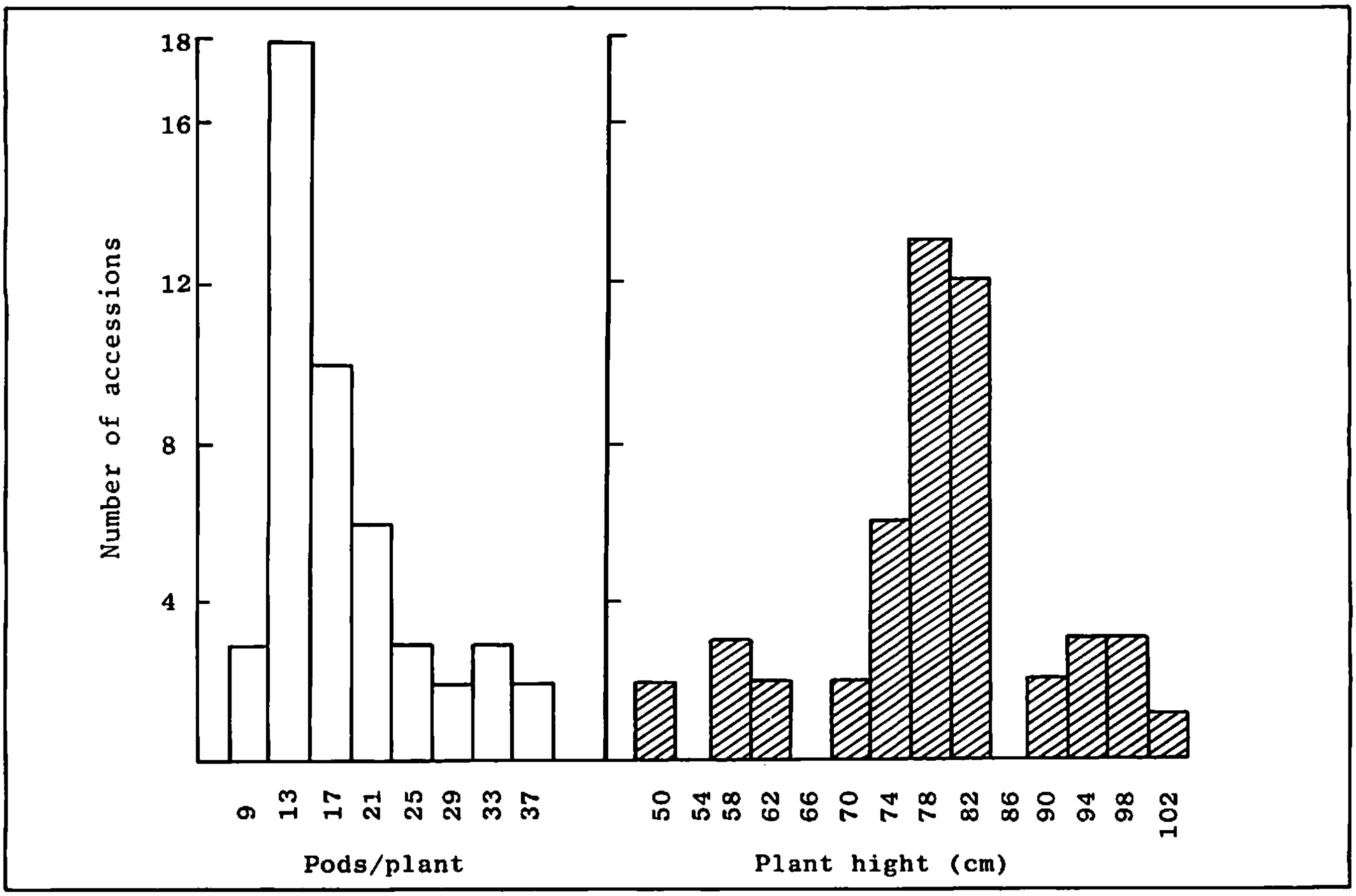

Fig. 5. Frequency distribution for number of pods/plant and plant height in 44 germplasm accessions of Wollo faba beans grown at Bekoji during the 1982/83 season.

At Debre Zeit, although days to flowering was negatively correlated with grain yield, its effect was evident on final grain yield. Diseases such as chocolate spot and rust were important in determining grain yield. In this study, there was no significant correlation between chocolate spot and grain yield. Whereas, rust had a negatively significant correlation (P<0.05) and highly affected the yield. Although plant height exhibited a positive correlation, this was not significantly related to final grain yield expression. Number of flowers/plant had a significantly negative correlation (P<0.05) with grain yield. The number of pods/plant and number of seeds/pod had a positive correlation, but their effect on grain yield was not significant. Days to flowering showed a significant correlation (P<0.05) with each of, number of flowers/plant, number of pods/plant, and number of seeds/pod. Number of seeds/pod was negatively correlated with number of flowers/plant, but positively correlated with number of pods/plant.

Correlations among various growth parameters for the 44 faba bean accessions grown at Bekoji are shown in **Table 4**. Grain yield was highly significantly correlated with days to flowering, plant height, and plant stand. Number of pods/plant and rust disease correlated poorly with grain yield.

Discussion

The common feature of the six administrative regions, from which the different faba bean accessions were collected, is that they fall on a high plateau with dissected tablelands that has suffered considerable

Table 3. Simple correlations among different characters of Wollo faba bean grown at Debre Zeit during 1982/83 season.

Character	Days to flowering	Chocolate spot score	Rust score	Plant height	Flowers/ plant	Pods/ plant	Seeds/ pod
Yield	-0.087	0.158	0.231*	0.119	-0.282*	0.122	0.107
Days to flowering		-0.078	-0.075	-0.039	-0.269*	-0.275*	-0.320*
Chocolate spot score			-0.294*	-0.219	-0.172	0.121	0.103
Rust score				0.183	0.078	0.140	-0.128
Plant height					-0.078	0.286*	0.013
Flowers/plant						-0.289*	0.285*
Pods/plant							-0.421***
Seeds/plant							

*, **, and *** indicate significance at P < 0.05, P < 0.01, and P < 0.001, respectively.

Table 4. Simple correlations among different pairs of characters of Wollo faba bean grown at Bekoji during the 1982/83 season.

Character	Stand	Days to flowering	Plant height	Chocolate spot score	Rust score	Pods/ plant	Seeds/ pod	Yield
Stand		-0.385**	0.553***	0.086	-0.164	-0.240	0.042	0.693***
Days to flowering			-0.294	-0.106	-0.110	0.054	-0.140	-0.414**
Plant height				-0.173	-0.357	0.077	0.133	-0.786
Chocolate Spots score					0.341	-0.163	0.027	-0.219
Rust score						-0.479	0.020	-0.264
Pods/plant							0.060	-0.124
Seeds/pod								0.010
Yield								

*, **, and *** indicate significance at P < 0.05, P < 0.01 and P < 0.001, respectively.

erosion (Westphal 1974). In these regions, the ecological degradation is high. This resulted from over -grazing, intensive cultivation, and dense population. The altitude of these regions is between 2325-2650 m. Therefore, severe lodging and frost damage are the major factors affecting faba bean production. However, at Amosel sub-province with an altitude of 2650 m, up to 54 pods/plant were counted on some faba bean plants.

Seeds of the collected faba bean accessions were characterized by small - medium seed size with light green color. The hilum color was black, light dark brown, or white.

The evaluation work at Debre Zeit shows that number of flowers/plant is a good contributor to grain yield, mainly because it increased the number of pods/plant. This was reflected in a better yield. On the other hand, late flowering and plant height had negative effects on the yield. Late flowering coincided with insufficient rainfall towards maturity, resulting in poor pod set. Plant height over 120 cm caused considerable lodging and excessive flower drop. Besides this, excessive plant height creates serious competition for metabolites during pod formation and early grain filling stages (Molden and Bond 1960; Peat 1982). Therefore, in breeding programs, selection of accessions that give little vegetative growth after flowering will be highly beneficial.

Also at Debre Zeit, starting mid-September, the relatively high temperature combined with limited rainfall had caused a high amount of pod drop. Seltzer and Evans (1976) reported that faba bean is sensitive to unfavorable moisture conditions, i.e., high or low moisture levels.

At Bekoji, unlike at Debre Zeit, the main contributors to faba bean yield were plant population at harvest (plant stand) and plant height. Therefore, this information strongly confirms the common observation that faba bean, like most other food legumes, is location specific in adaptation.

Acknowledgments

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بعض ارتباطات مظهرية هامة لأصول وراثية من الفول (Vicia faba L.) في Wollo

ملخص

في محاولة لجمع أو تركيب عشيرة للعمل على تحسين الغلة البذرية والجودة في الفول Vicia faba L. أخذت مجموعة أصول وراثية من ست مناطق إدارية في Wollo خلال تشرين الثاني/نوفمبر وكانون الأول/ديسمبر 1981 ، وذلك تحت إشراف المركز الأثيوبي للمصادر الوراثية النباتية . وخلال عملية الجمع الحقلية تم تسجيل قراءات لون البذور وحجمها ولون السرة على كل عينة . كما سجلت الأضرار الملحوظة الناجمة عن حفار القرون ، والصقيع ، والتبقع الشوكولاتي ، والصدأ ، والرقاد . وفي عملية التقييم التالية التي أجريت على 60 مدخلاً في دبر الزيت ، جرى تقييم لثماني صفات مظهرية هامة بالإضافة إلى الغلة . وقد ظهر أكبر تباين في طول النبات يليه عدد الأزهار/النبات ، والغلة البذرية ، وعدد القرون/النبات ، ولم يرتبط طول النبات بالغلة البذرية . وفي محطة بحوث بيكوجي أظهر تقييم 44 مدخلاً لتحديد ثماني صفات مظهرية أن أعلى تباين وراثي ظهر في الغلة البذرية يليها طول النبات ، إذ حدث هنا ارتباط بين الأخير وعدد الأيام حتى الإزهار ، مما كان له تأثير معنوي على الغلة البذرية.وقد أعطت النباتات بطول100 إلى 105 سم أفضل غلة بذرية . وكان التعبير عن التباين في مكونات الغلة أفضل في دبر الزيت منه في بيكوجي .

Physiology and Microbiology

الفيزيولوجيا والأحياء الدقيقة

Effect of Moisture Stress at Different Stages of Plant Growth on Faba Bean Seed Yield

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Abstract

The response of faba bean to water stress at different stages of plant growth (*viz.* early vegetative, early pod development, and late grain filling stages) was studied at three different sites in the Sudan. The results showed that omission of one irrigation during the vegetative phase produced no significant effect on yield as compared to the continuous 10-day irrigation regime. In contrast, water stress during the reproductive phase resulted in considerable reduction in seed yield, and early pod development was the most sensitive stage of plant growth to water stress. The present study showed that a saving of three irrigations can be achieved by adopting a continuous 15-day regime which was less damaging than missing only two irrigations during the reproductive stage of growth.

Introduction

Water management is an important factor in faba bean production in Sudan. The results of field trials at Hudeiba Research Station showed clearly the sensitivity of the crop to water stress during the reproductive phase. These investigations indicated that water can be saved during the vegetative phase by adopting a flexible watering regime which uses a wider irrigation interval early in the growing season and a shorter one during the reproductive phase with very little losses in grain yield (Ageeb 1979, 1981).

Salih and Ageeb (1983) reported that watering every 7 days increased grain yield by 128% and 83% over that of the 14-day regime at Wad Medani and Shambat, respectively. Fadl (1982) reported that the crop uses about 5960 m^3/ha of water during the growing season. The daily evapotranspiration can reach a maximum of 11.3 mm during January. The pattern of crop water use is parabolic: it follows the development of leaf canopy, reaching a peak in late December to mid-January, and declines from mid-February. The purpose of this experiment was to investigate the possibility of saving irrigation water by withholding watering at some stages of crop growth with minimal loss in grain yield.

Materials and Methods

The effect of withholding irrigation once, twice, or thrice at different stages of plant growth, i.e., early vegetative phase, pod development, late grain filling, and their different combinations was compared to regular watering at 10- and 15-day intervals throughout the growing season. The following treatments were arranged in a randomized complete block design with four replications:

Treat-ment no.	No. of irriga-tions	Stage when irrigation was applied (days after sowing)												
		Sowing	Early vegetat-ive				Pod develop-ment				Late grain filling			
		0	7	17		27	37	47		57	67	77		87
1	10	x	x	x		x	x	x		x	x	x		x
2	7	x	x		x		x		x		x		x	
3	9	x	x			x	x	x		x	x	x		x
4	9	x	x	x		x	x	x			x	x		x
5	9	x	x	x		x	x	x		x	x			x
6	8	x	x			x	x	x			x	x		x
7	8	x	x	x		x	x	x			x			x
8	8	x	x			x	x	x		x	x			x
9	7	x	x			x	x	x			x			x

x = irrigation applied.

The experiment was conducted during the 1981/82 season at three different sites: Hudeiba, Shambat, and Wad Medani. Seeds of the cultivar BF 2/2 were sown on 60-cm ridges at hill spacing of 10 cm, with two seeds per hill. The planting date was 20 Oct at Shambat, 3 Nov at Hudeiba, and 17 Nov 1980 at Wad Medani. Meteorological data for the three sites during the growing season are presented in **Table 1.**

Results and Discussions

Grain yield (Table 2) differed greatly at the three sites. The highest grain yield (1999 kg/ha) was obtained at Shambat site, whereas the lowest yield (708 kg/ha) was recorded at Wad Medani. The yield at Hudeiba was second best (1864 kg/ha).

At Hudeiba, treatment 1 (watering at 10-day intervals) and treatment 3 (missing one irrigation at early vegetative phase) yielded significantly more than the other treatments. Watering every 15 days reduced the yield by 25% as compared to the continuous 10-day regime. Yield was reduced by about 46% and 21.5% when one irrigation was missed during pod development (treatment 4) and late grain filling stage (treatment 5), respectively. Saving of two waterings by withholding irrigation during the vegetative and late grain filling phases reduced the yield by only 23%, whereas withholding two irrigations during pod development and late grain filling stages reduced the grain yield by 46%. The lowest yield was recorded in treatment 9 where irrigation was withheld once in each of the three stages of plant growth.

At Shambat, yield response to water stress during plant growth was statistically significant in all the

Table 1. Meteorological data for Hudeiba, Shambat, and Wad Medani sites during the 1981/82 growing season.

Month	Hudeiba			Shambat			Wad Medani		
	Mean max temp. (°C)	Mean min temp. (°C)	Evaporation (mm/day)	Mean max temp. (°C)	Mean min temp. (°C)	Evaporation (mm/day)	Mean max temp. (°C)	Mean min temp (°C)	Evaporation (mm/day)
Oct	39.6	25.4		39.9	24.8	16.4	38.6	22.5	11.8
Nov	33.6	19.0	19.1	33.8	19.7	17.3	35.6	18.7	14.6
Dec	32.7	17.9	12.6	33.6	17.6	12.2	35.1	17.5	11.7
Jan	30.3	15.5	14.4	32.0	15.4	12.0	34.0	16.6	13.0
Feb	28.4	11.7	15.8	29.1	13.3	13.8	33.0	15.2	15.3

Table 2. Effect of water stress at various stages of plant growth on grain yield of faba bean at Hudeiba, Shambat, and Wad Medani.

Treatment	Yield (kg/ha)		
	Hudeiba	Shambat	Wad Medani
1. Irrigation every 10 days	2571	2840	974
2. Irrigation every 15 days	1919	1847	646
3. As (1) but the 3rd irrigation missed	2596	2612	957
4. As (1) but the 7th irrigation missed	1389	2025	678
5. As (1) but the 9th irrigation missed	2017	1962	801
6. As (1) but the 3rd and 7th irrigations missed	1547	1856	593
7. As (1) but the 7th and 9th irrigations missed	1387	1655	561
8. As (1) but the 3rd and 9th irrigations missed	1981	1543	646
9. As (1) but the 3rd, 7th, and 9th irrigations missed	1374	1652	513
Mean	1864	1999	708
SE ±	85.7	112	63

cases except when the stress was imposed during the first phase of plant development (**Table 2**). Watering every 15 days reduced the yield by about 35% as compared to the continuous 10-day regime. Yield reduction was about 28.7% when one irrigation was missed during pod development and 30.9% when water stress was imposed during the late grain filling phase. Saving of two waterings by withholding irrigation during both the vegetative and late grain filling phases resulted in a yield reduction of 45.6%, whereas saving of two waterings by missing irrigation during pod development and late grain filling phases reduced the grain yield by 41.7%. The lowest yield was obtained from treatment 9 where water stress was imposed during all the three phases of plant development.

At Wad Medani, grain yield response to the different watering regimes was more or less similar to that recorded at Hudeiba site. Watering every 15 days led to a yield reduction of 33% as compared to the 10-day watering regime (**Table 2**). Omission of the 3rd irrigation (early vegetative stage) did not affect grain yield, but when the 7th irrigation (pod development) was missed, grain yield was reduced by about 30%. On the other hand, when the 9th irrigation (late grain filling) was not given, yield was reduced by 18%. Stress at additional stages reduced the grain yield further and the magnitude of losses was more than additive when the 3rd and 7th irrigations were missed, as perhaps soil moisture losses were not fully compensated for by intermediate irrigations. These data together with those of the Hudeiba site confirm the previous findings by Ageeb (1981) and Mohamed (1981), who reported that among the different stages of plant development, the reproductive stage is the most affected by moisture stress and that within the reproductive stage, late flowering and early pod development are the most sensitive to water stress.

In general, the results of this study show that the saving of three irrigations by adopting a continuous 15-day regime had a less drastic effect on grain yield than the saving of two waterings during the early reproductive and late grain filling stages of plant growth. Probably the plants of the former treatment produced longer roots that could tap the moisture lying deep in the soil and/or developed a well-balanced shoot: root ratio and became adapted to water stress, compared to those plants receiving the stress only during the reproductive phase of plant development.

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تأثير إجهاد الرطوبة في مختلف مراحل نمو النبات على الغلة البذرية للفول

ملخص

درست ردود فعل الفول على إجهاد الرطوبة الحاصل في مراحل مختلفة من نمو النبات (كالنمو الخضرى المبكر ، وبداية تطور القرون ، ونهاية مرحلة امتلاء الحبة) ، وفي ثلاثة مواقع مختلفة بالسودان . وقد أظهرت النتائج أن عدم إعطاء رية واحدة خلال مرحلة النمو الخضرى لم يوءثر معنويا على الغلة ، بالمقارنة معنظام رى مستمر كل عشرة أيام. وبالمقابل أدى إجهاد الرطوبة في مرحلة تكاثر النبات إلى انخفاض كبير في الغلة البذرية ، وكان طور بداية تطور القرون من أكثر مراحل نمو النبات حساسية لإجهاد الرطوبة . كما أظهرت الدراسة الحالية إمكانية توفير ثلاث ريات باتباع نظام رى مستمر كل 15 يوما ، لأن ذلك كان أقل ضررا من عدم إعطاء ريتين فقط خلال مرحلة التكاثر .

Early Screening of Faba Bean (Vicia faba L.) for Drought Resistance

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Abstract

In a nutrient solution test 10 cultivars of faba bean were exposed to increasing levels of osmotic stress obtained by addition of polyethylene glycol (PEG) 6000. Seedling behaviour was analysed at -4.8, -7.8, and -12.7 x 10^5Pa, corresponding to mild, moderate, and severe stress, respectively. Treated and control plants were analysed for growth, gas exchange, abscisic acid (ABA) content, and leaf water and osmotic potential. Cultivars differed significantly in their sensitivity to drought stress. To compare the results of hydroponic tests with field reaction, six cultivars were further tested in the field by growing them with and without irrigation. Significant correlation was found between grain yield in the moisture stress situation in field and specific parameters measured on plants grown in nutrient solution (r = 0.61 to 0.91 for gas exchange and ABA concentrations). Correlation was even better (r= 0.71 to 0.93) when a large seeded cultivar (Optica) that escaped natural drought stress in the field because of early maturity was excluded from the computation. The results indicate that screening of faba bean with PEG in nutrient solution can be done quickly and provides sufficiently reliable results for characterizing the drought tolerance in faba bean.

Introduction

The lack of yield stability in faba bean because of variable climatic conditions (Hawtin and Hebblethwaite 1983) has necessitated crop improvement efforts to breed cultivars capable of enduring water stress. Breeding for drought resistance has been accomplished by selecting for seed yield under field conditions, but since such procedure requires full season field data, it is not always an efficient approach, especially in mesic locations. An alternative may be to screen material under laboratory or greenhouse conditions using seedlings as test material (Bouslama and Schapaugh 1984).

The aim of this study was to find a method to screen for drought resistance of faba bean in the seedling stage. It was attempted to evaluate the effects of osmotic stress on faba bean growth with special attention to the question of the existence of variation in physiological adaptation to stress. The usefulness of this approach depends on whether or not faba bean seedling response to a drought experience will accurately predict the performance of the mature plant, and especially yielding ability. This study was undertaken to assess whether such responses were associated with yield of the faba bean cultivars under water stress in field situations.

Materials and Methods

Screening test

The following faba bean cultivars (supplied by Bundesanstalt fuer Pflanzenbau in Vienna) were used in the tests: Alfred, Bolero, Debek, Faneta, Karna, Kornberger Kleinkoernige, Kristall, Wieselburger Kleinkoernige (all small seeded) and the large seeded cultivars Minica and Optica.

The experiments were performed in a greenhouse under natural light supplemented by Phillips HLRG 400 W lamps for 14 h/day.

Nutrient solution culture experiments were conducted with polyethylene glycol (PEG) 6000 (Merck) as an osmoticum. The nutrient solution contained 4.0 mmol NO_3^-, 3.5 mmol K^+, 0.5 mmol $H PO_4^{--}$ and $H_2PO_4^-$ in a ratio of 9:1, 0.5 mmol Ca^{++}, 0.2 mmol Mg^{++}, and 0.25 mmol SO_4^{--} (Steineck 1972). The solution was changed weekly. The osmotic potential of the nutrient solution of the treated plants was adjusted by addition of PEG 6000 to the growing medium in amounts calculated with the formula of Michel and Kaufmann (1973).

The seedlings were allowed to grow in the basic nutrient solution for seven days. Then half of the plants were exposed to water stress by changing the osmotic potential of the solution at a rate of approximately -1.0×10^5Pa/day. Addition of PEG was temporarily suspended when the osmotic potential of the nutrient solution had reached -4.8×10^5Pa (mild stress), -7.8×10^5Pa (moderate stress), 12.7×10^5Pa (severe stress) and the first, second, and third harvests were performed. The total time required for inducing stress was 20 days. A similar scheme of stress induction was formerly described by Mougou *et al.* (1984).

At the three harvests, length of shoot as well as fresh and dry matter of roots and shoots were determined. CO_2 assimilation rate, transpiration rate, and stomatal resistance were examined with a LICOR - 6000 Portable Phytosynthesis System (Soja 1986) at mid-day on the youngest fully expanded leaf. Leaf water potential and leaf osmotic potential were measured using a pressure chamber and a Wescor dewpoint microvoltmeter (HR-33 T) equipped with a C-52 sample chamber. Cis (+) - abscisic acid (ABA) in leaves was assessed with monoclonal antibodies (Idetek, Inc.) according to Weiler (1982) in an ELISA test.

Field experiment

Trials in the field were performed in 1987 at the Experimental Station of the University of Agriculture in Großenzersdorf, Austria. Cultivars used were Alfred, Bolero, Faneta, Karna, Optica, and Wieselburger Kleinkoernige. For irrigated plots water was added by drip irrigation (225 mm) after the onset of flowering; control plots received natural precipitation only.

Results and Discussion

Screening Test

Growth and physiological parameters of control and stressed plants are presented for the second harvest at -7.8×10^5Pa in the nutrient solution (**Table 1**).

The analysis of variance for the different parameters measured in the seedling test at moderate stress showed significant differences among the cultivars of both treatments (control and osmotically stressed) for growth and gas exchange parameters. These cultivar differences are less useful for separation of cultivars for drought response because the intrinsic cultivar differences were confounded with the effects of the osmotic treatment. However, significant cultivar x treatment interactions existed as more meaningful indicators for different patterns of cultivar response to the drought stress simulation. Significant differences were also present among the treatments for all variables across all cultivars except for root dry matter production at the second harvest (**Table 1**).

Table 1. The effect of water stress (using nutrient solution at -7.8×10^5 Pa) on the growth and physiological parameters of faba bean plants from the second harvest. Analysis of variance and means across all cultivars and coefficient of variation are also included.

Character	Mean		Coefficient of variation		Analysis of variance[1]		
	Non stressed	Stressed	Non stressed	Stressed	Cultivar	Treatment	Interaction treatment x cultivar
Shoot length (cm)	32.80	27.00	0.15	0.11	***	***	*
Shoot dry matter (mg)	907.00	675.00	0.27	0.28	***	***	*
Root dry matter (mg)	175.00	174.00	0.31	0.30	***	ns	***
Stomatal resistance (s/cm)	1.52	23.36	0.21	0.48	**	***	**
Transpiration rate ($mgH_20/m^2/s$)	64.61	7.64	0.12	0.33	***	***	***
CO_2 exchange rate ($mgC0_2/m^2/s$)	0.36	0.18	0.22	0.21	***	***	**
Abscisic acid (nmol/100mgFM)	3.12	17.78	0.06	0.34	ns[2]	***	nc[3]
Total leaf water potential (10^5Pa)	-7.00	-8.70	0.11	0.08	ns	***	ns
Leaf osmotic potential (10^5Pa)	-9.00	-10.70	0.11	0.12	ns	*	nc

1. *, **, and *** indicate significance at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.
2. ns = not significant.
3. nc = not calculated because of the small number of replications.

Table 1 shows that shoot dry matter production was more influenced by the stress treatment (26% reduction) than shoot length (18% reduction) or root dry matter (1% reduction), which even exceeded the control in some cultivars, indicating a higher potential of continuing root growth under stress. Shoot growth reduction was smallest in Karna and Kristall; root growth was more enhanced by stress in Faneta and Karna than in the other cultivars. The most negative effects concerning these characters could be seen in Wieselburger Kleinkoernige, Optica, Alfred, and Kornberger Kleinkoernige.

Gas exchange was more affected than the growth parameters. Stomatal resistance was 15 times higher in the stressed plants, and the coefficient of variation was also remarkably raised. Transpiration rate was more sensitive to stress than net photosynthesis (12% vs. 48% of control). Transpiration rate already started to decrease at an osmotic potential of -1.8 x 10^5Pa in the nutrient solution but photosynthesis did not. According to Schulze (1986) photosynthesis is usually less reduced under low soil water potential than transpiration when stomata start to close. Water use efficiency (mol CO_2/mol H_2O) was higher for stressed than for unstressed plants. Coefficients of variation differed between stressed and unstressed plants for stomatal resistance and transpiration but not for photosynthesis. Increase of stomatal resistance and decrease of transpiration and photosynthesis were smallest in Bolero and most distinct in Alfred.

Abscisic acid concentration (ABA) in the youngest fully developed leaf increased about sixfold at the moderate stress level (-7.8 x 10^5Pa). Faneta showed the highest level and Kristall the lowest level of all cultivars. Differences among cultivars could not be ascertained by statistical analysis but might be detectable with more replications. The concentrations in control leaves were about 3 nmol/100 mg fresh matter and thus somewhat higher than levels reported by Cornish and Zeevarrt 1986) but were in the normal range of mesophytes (Passos 1985).

Significant differences among cultivars for leaf water potential could not be found, but at other stress levels or in other tests with more replications this was possible (results not shown).

Field experiment

Faba bean seed yield was strongly affected by water stress during flowering and pod setting. Yield decreased by about 25% on average without irrigation. However, the influence of irrigation varied among cultivars (**Table 2**). Optica exhibited the smallest (-5%) and Wieselburger Kleinkoernige the highest reduction (-35%).

Table 2. Seed yield (t/ha) of six faba bean cultivars in the field.

Cultivar	Yield[1] Non irrigated	Irrigated
Alfred	4.70 cd	6.01 e
Bolero	3.56 a	4.98 d
Faneta	4.11 abc	5.89 e
Karna	3.34 bcd	5.73 e
Optica	4.56 cd	4.81 d
Wieselburger Kleinkoernige	3.74 ab	5.77 e

[1] Means followed by the same letters are not statistically different at $P < 0.05$.

Dantuma *et al.* (1983) described a better response of large seeded cultivars of faba bean to favourable environments. The only large seeded cultivar used in this experiment (Optica) showed the smallest increase in yield after irrigation. However, this result may partly be due to the faster development of Optica enabling it to take advantage of more abundant natural rainfall in spring.

Correlations between screening test and field experiment

Correlations between performance of the plants in the nutrient solution and seed yield in the field were mostly significant (**Table 3**). Coefficients of correlation were even better when data on Optica were omitted from computation. Gas exchange and ABA concentration even with mild osmotic stress in the nutrient solution were significantly correlated with seed yield in the field. Under moderate and severe stress the other parameters except root dry matter and partly osmotic potential also showed significant correlation. Mackay and Barber (1984) stated that root growth in nutrient solution need not necessarily be coherent with root growth in the soil, requiring caution when applying results to field environments. Among all the parameters tested transpiration rate in the greenhouse experiment has the highest correlation (+0.89) with seed yield in the field.

Leone *et al.* (1987) found better correlations between photosynthesis and yield than between transpiration, stomatal resistance, or dry matter and yield for peas.

Table 3. Correlation coefficients between seed yield in the field (calculated with and without Optica) and results of the nutrient solution test.

Character	Including Optica			Without Optica		
	Mild stress ($4.8x10^5$Pa)	Moderate stress ($7.8x10^5$Pa)	Severe stress ($12.7x10^5$Pa)	Mild stress ($4.8x10^5$Pa)	Moderate stress ($7.8x10^5$Pa)	Severe stress ($12.7x10^5$Pa)
Shoot length	ns[1]	+0.62	+0.80	ns	+0.78	+0.89
Shoot dry matter	ns	+0.64	+0.66	ns	+0.76	+0.93
Root dry matter	ns	ns	ns	ns	ns	ns
Stomatal resistance	-0.83	-0.65	-0.72	-0.87	-0.72	-0.77
Transpiration rate	+0.87	+0.91	+0.82	+0.90	+0.93	+0.88
CO_2 exchange rate	+0.69	+0.83	+0.61	+0.80	+0.84	+0.71
Abscisic acid	-0.72	-0.78	-0.70	+0.77	-0.82	-0.77
Total leaf water potential	ns	+0.76	+0.80	ns	+0.78	+0.87
Leaf osmotic potential	ns	ns	+0.81	ns	ns	+0.84

1. ns = not significant.

Bouslama and Schapaugh (1984) stated that a hydroponic seedling test with PEG was more reliable in predicting drought resistance than any other screening test in soybean. Smith *et al.* (1985) used PEG in cell culture for screening for drought tolerance in sorghum. Other tests, used osmotic stress on seeds or excised leaf tissue, thermal stress or with-holding of water, resulted in relationships between physiological parameters and drought tolerance of cereals in the field (Martiniello and Lorenzoni 1985; Sinha and Patil 1986; Kaul and Muendel 1987). ABA accumulation in several tests of maize and wheat was related to drought tolerance (Innes *et al.* 1984, Pekic and Quarrie 1987).

Conclusions

Cultivar differences in seedling response to drought are evident (**Table 1**). A single growth or physiological character is not as reliable for assessing cultivar performance under drought stress than a combination of parameters including gas exchange.

The hydroponic test appears to be a reliable and efficient procedure to screen for drought resistance of faba bean cultivars (Jones 1983).

Apparently plants may exhibit additional resistance mechanisms in the field which are incompletely simulated by osmotic stress in nutrient solution, e.g., drought escape by earliness. This suggests the desirability of a confirmation of plant behaviour under field conditions.

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الغربلة المبكرة لمقاومة الجفاف في الفول (Vicia faba L.)

ملخص

في اختبار بمحلول مغذ ، عُرّضت عشرة أصناف من الفول إلى مستويات متزايدة من الإجهاد الحلولي (الأوسموزي) ، الذي تم إحداثه بإضافة بولي اثيلين جليكول (PEG 6000 (كحول ثنائي التكافوء) . وتم تحليل سلوك البادرات عند – 4.8 و – 7.9 و –12.7 × 10^5 Pa وهي معادلة لضغط خفيف ومتوسط وشديد على التوالي . وبعد تحليل النباتات المعاملة ونباتات الشاهد لتحديد النمو ، والتبادل الغازى ، والمحتوى الحامضي من abscisic acid(ABA) ، وكمون ماء الورقة ،والكمون الحلولي ، ظهر تباين الأصناف بشكل معنوى في مدى تحسسها لإجهاد الجفاف . ولمقارنة نتائج اختبارات الزراعة المائية مع ردود الفعل الحقلية ، أجريت مزيد من الاختبارات على ستة أصناف في الحقل زرعت تحت الظروف المروية وغير المروية . وقد وجد ارتباط معنوى بين الغلة البذرية في حالة إجهاد الرطوبة في الحقل ، والمعايير النوعية المقاسة على نباتات مزروعة في محلول مغذ (معامل الارتباط "ر" =0.61 الى 0.91 للتبادل الغازى وتراكيز ABA). بل وكان الارتباط أفضل (ر = 0.71 الى 0.93) بعد استبعاد الصنف (Optica)،الكبير الحبة،من الحساب ، ذلك أنه هرب من إجهاد الجفاف الطبيعي في الحقل ، بسبب تبكيره في النضج . وتشير النتائج إلى أن غربلة الفول باستعمال محلول مغذ PEG يمكن أن تتم بسرعة ، وتعطي نتائج موثوقة بما فيه الكفاية لتحديد مدى تحمل نباتات الفول للجفاف .

Growth Analysis in Faba Bean (Vicia faba L.)

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Abstract

An experiment was conducted during the winter seasons of 1980/81 and 1982/83 at the Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, to study the growth behaviour of faba bean under different plant densities. The treatments included two genotypes (UPS 1 and BS 1) and five plant densities (12.5, 25, 50, 100, and 200 plants/m^2). Significantly higher LAR was recorded at both the growth stages (35-70 and 70-105 days after sowing) with 100 plants/m^2 during 1980/81 and with 25 and 50 plants/m^2 during 1982/83. $\overline{LAI}$ and $\overline{CGR}$ increased whereas $\overline{RGR}$, $\overline{NAR}$, and $\overline{RLGR}$ declined with increase in density at both stages of crop growth.

Introduction

Faba bean (*Vicia faba* L.) which is one of the major food legumes in the world, is newly introduced to Indian agriculture. The crop has high yield potential but this is often not realized in the field. Growth analysis is a useful tool to study the complex interactions between plant growth and crop environment in the yield build-up of the crop. Such studies on faba bean under the sub-humid tropical conditions of Nainital Tarai, north India have not been undertaken in the past. A trial was therefore undertaken to study the crop growth rate (CGR), leaf area index (LAI), net assimilation rate (NAR), leaf area ratio (LAR), and relative leaf growth rate (RLGR), as affected by plant population in two cultivars of faba bean.

Materials and Methods

A field experiment was conducted during the *rabi* (winter) seasons of 1980/81 and 1982/83 at the Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar under irrigated conditions to study the growth behaviour of two faba bean cultivars under different plant densities.

The soil in 1980/81 was loam, low in organic carbon (0.54%), high in available phosphorus (60.5 kg P/ha), and medium in available potassium (188 kg K/ha). The soil in 1982/83 was silty-clay-loam with high organic carbon (0.98%), medium in available phosphorus (19.5 kg P/ha), and high in available potassium (357.6 kg K/ha). Both soils were neutral in reaction. A uniform basal application of diammonium phosphate (18% N and 46% P_2O_5) was made at the rate of 100 kg/ha. In both seasons, the crop was sown during the first week of November and harvested during the first week of April.

The treatments consisted of two cultivars viz. UP Selection 1 (UPS 1) and Bihar Selection 1 (BS 1) and five plant densities (12.5, 25, 50, 100, and 200 plants/m^2). Treatments were arranged in a randomized block design with four replications. To obtain the desired plant density, two seeds/hill were sown at a distance of 2.5, 5, 10, 20, and 40 cm in fixed rows 20 cm apart. Only one seedling at each place was maintained by thinning done 20 days after sowing. Data on plant dry weight and leaf area were taken from a sample of 1 m row from each plot at 35, 70, and 105 days after sowing. Leaf area/plant was calculated by the punch method as described by Watson (1937, 1952). Various growth parameters ($\overline{LAI}$, $\overline{CGR}$, $\overline{RGR}$, $\overline{NAR}$, $\overline{LAR}$ and $\overline{RLGR}$) were computed according to Radford (1967).

Results and Discussion

Mean leaf area index ($\overline{LAI}$): Maximum rate of increase in $\overline{LAI}$ (0.07/day) was observed during the period from 70 to 105 days after sowing (**Table 1**). UPS 1 recorded significantly higher $\overline{LAI}$ over BS 1 at 105 days after sowing during 1980/81, whereas BS 1 produced significantly higher $\overline{LAI}$ over UPS 1 at this stage during the 1982/83 season. $\overline{LAI}$ increased significantly with increase in plant density up to 200 plants/m^2 at all the three stages of crop growth during both the years except that the difference in $\overline{LAI}$ between 100 and 200 plants/m^2 was not significant at 105 days during 1982/83. Shibles and Webber (1965) and Shalaby and Mohemed (1978) reported similar results with soybean and faba bean, respectively.

Mean crop growth rate ($\overline{CGR}$): Relatively higher $\overline{CGR}$ was obtained during the first year as compared to the second year (**Table 2**). $\overline{CGR}$ was quite low during the early stages of growth, i.e., 35-70 days after sowing.

Table 1. Mean leaf area index ($\overline{LAI}$) as affected by cultivar and plant density during the 1980/81 and 1982/83 seasons.

Treatment	Days after sowing					
	35		70		105	
	1980/81	1982/83	1980/81	1982/83	1980/81	1982/83
Cultivar						
UPS 1	0.35	0.52	1.71	2.01	4.20	4.18
BS 1	0.36	0.50	1.72	2.05	3.90	6.05
LSD (5%)	0.01	0.01	NS[1]	NS	0.14	0.42
Plant density (plants/m^2)						
12.5	0.18	0.28	1.14	1.33	2.70	3.02
25	0.26	0.43	1.23	1.66	3.20	3.87
50	0.37	0.49	1.60	3.11	4.20	4.72
100	0.46	0.63	2.16	2.40	4.80	5.80
200	0.52	0.70	2.45	2.61	5.30	5.67
LSD (5%)	0.01	0.02	0.10	0.13	0.22	0.67

1. NS = Non-significant.

after which it increased markedly. UPS 1 attained significantly higher $\overline{CGR}$ at 70-105 days after sowing during 1980/81 as compared to BS1,but in 1982/83 this was reversed. $\overline{CGR}$ increased significantly with increase in plant density up to 200 plants/m^2 during both years except that the differences between 12.5 and 25 plants/m^2 at 35-70 days during both seasons, and between 100 and 200 plants/m^2 at 70-105 days during the 1982/83 season, were not significant. Ishag (1973) reported that $\overline{CGR}$ over the whole growth period was 30% higher in dense (57 plants/m^2) than in sparse (35 plants/m^2) population.

Mean relative growth rate ($\overline{RGR}$): $\overline{RGR}$ was slightly higher during the first year as compared to the second year (**Table 2**). In the 1980/81 season, UPS 1 had significantly higher $\overline{RGR}$ than BS 1 at 70-105 days whereas in 1982/83 BS 1 attained significantly higher $\overline{RGR}$ than UPS 1 at 35-70 and 70-105 days after sowing. In both seasons, the highest values of RGR were recorded at the lowest plant density (12.5 plants/m^2) at 35-70 days. However, at 70-105 days 50 plants/m^2 resulted in significantly higher $\overline{RGR}$ over remaining densities during 1980/81, whereas during 1982/83, the differences among different densities were not significant. Shalaby and Mohemed (1978) also recorded a higher value of $\overline{RGR}$ with reduced plant density.

Mean net assimilation rate ($\overline{NAR}$): During the 1980/81 season $\overline{NAR}$ was higher at 70-105 days than at 35-70 days (**Table 2**). Also, at 70-105 days, there was a rapid increase in dry matter accumulation and production of more functional leaves. During the two seasons 1980/81 and 1982/83, significantly higher values of $\overline{NAR}$ were recorded at the lowest plant density (12.5 plants/m^2) during the first stage of growth (35-70 days). This is in agreement with the findings of Shalaby and Mohemed (1978). However, in the second stage of growth (70-105 days) significantly higher values of $\overline{NAR}$ were recorded with 50 plants/m^2 over 12.5, 100 and 200 plants/m^2 during the 1980/81 season, and with 100 and 200 plants/m^2 over 12.5, 25 and 50 plants/m^2 during the 1982/83 season.

Mean leaf area ratio ($\overline{LAR}$): $\overline{LAR}$ decreased with advancement in crop age during both the years (**Table 3**). During 1980/81, BS 1 attained significantly higher $\overline{LAR}$ than UPS 1 at both stages of growth, but it had lower LAR than UPS 1 at the first stage of growth (35-70 days) during the 1982/83 season. Significantly higher $\overline{LAR}$ was obtained at both the stages of growth with 100 plants/m^2 during the 1980/81 season and with 25 plants/m^2 which remained at par with 50 plants/m^2 during the 1982/83 season as compared with the remaining densities.

Mean relative leaf growth rate ($\overline{RLGR}$): In both seasons, the highest values of $\overline{RLGR}$ were recorded during the period 35-70 days as compared with the period 70-105 days (**Table 3**). BS 1 had significantly higher values of $\overline{RLGR}$ than UPS 1 at the two stages of growth during the 1982/83 season, whereas during 1980/81, significantly

Table 2. Mean crop growth rate ($\overline{CGR}$), mean relative growth rate ($\overline{RGR}$), and mean net assimilation rate ($\overline{NAR}$) as affected by cultivar and plant density during the 1980/81 and 1982/83 seasons.

Treatment	CGR (g/m²/day)				RGR (g/g/day)				NAR (g/dm²/day)			
	1980/81		1982/83		1980/81		1982/83		1980/81		1982/83	
	35-70	70-105	35-70	70-105	35-70	70-105	35-70	70-105	35-70	70-105	35-70	70-105
Cultivar												
UPS 1	2.90	12.70	2.50	7.30	0.040	0.042	0.034	0.031	0.034	0.045	0.022	0.023
BS 1	2.84	10.54	2.75	8.33	0.040	0.039	0.035	0.032	0.033	0.039	0.024	0.024
LSD (5%)	NS[1]	0.32	0.09	0.44	NS	0.001	0.001	0.001	0.001	0.001	0.001	NS
Plant density (plants/m²)												
12.5	2.20	7.84	1.91	4.82	0.055	0.039	0.040	0.030	0.044	0.042	0.027	0.022
25	2.22	9.50	1.98	6.03	0.042	0.042	0.032	0.031	0.033	0.044	0.021	0.022
50	2.44	12.58	2.61	7.57	0.039	0.045	0.033	0.031	0.028	0.046	0.022	0.022
100	3.33	13.09	3.19	10.04	0.042	0.039	0.034	0.033	0.030	0.039	0.023	0.027
200	4.26	15.31	3.44	10.61	0.044	0.038	0.034	0.032	0.034	0.041	0.023	0.027
LSD (5%)	0.11	0.50	0.15	0.70	0.003	0.001	0.001	NS	0.002	0.003	0.002	0.002

1. NS = Non-significant.

Table 3. Mean leaf area ratio ($\overline{LAR}$) and mean relative leaf growth rate ($\overline{RLGR}$) as affected by variety and plant density during the 1980/81 and 1982/83 seasons.

Treatment	LAR (dm²/g)				RLGR (dm²/g/day)			
	1980/81		1982/83		1980/81		1982/83	
	35-70	70-105	35-70	70-105	35-70	70-105	35-70	70-105
Cultivar								
UPS 1	1.30	0.93	1.49	1.30	0.044	0.027	0.039	0.020
BS 1	1.33	0.98	1.44	1.34	0.044	0.024	0.040	0.025
LSD (5%)	0.03	0.02	0.03	NS[1]	NS	0.001	0.001	0.003
Plant density (plants/m²)								
12.5	1.25	0.92	1.45	1.33	0.050	0.027	0.044	0.023
25	1.27	0.95	1.52	1.39	0.043	0.028	0.038	0.023
50	1.35	0.97	1.48	1.39	0.051	0.027	0.047	0.022
100	1.40	1.02	1.43	1.27	0.044	0.023	0.038	0.024
200	1.31	0.93	1.45	1.22	0.042	0.023	0.037	0.021
LSD (5%)	0.05	0.04	0.05	0.04	0.002	0.002	0.002	NS

1. NS = Non-significant.

higher values of $\overline{RLGR}$ were recorded in UPS 1 as compared to BS 1 at 70-105 days. At the first stage of growth (35-70 days), $\overline{RLGR}$ was significantly higher with 12.5 and 50 plants/m² than with the remaining densities during the 1980/81 and 1982/83 seasons, respectively. At the second stage of growth (70-105 days) the plant densities 12.5, 25, and 50 plants/m² being at par resulted in significantly higher $\overline{RLGR}$ than 100 and 200 plants/m² during the 1980/81 season, whereas during the 1982/83 season the effects of various plant densities were not significant.

In a separate communication, the relationship of these growth parameters with the build-up of yield of the two cultivars of faba bean in relation to optimum plant population will be examined.

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تحليل النمو في الفول (Vicia faba L.)

ملخص

اجريت تجربة خلال الموسمين الشتويين 1980/81 و 1982/83 في مركز بحوث المحاصيل التابع لجامعة جوفيند بالاباه بانت للزراعة والتكنولوجيا في بانتنجار ، لدراسة سلوك نمو الفول تحت كثافات نباتية مختلفة . وقد تضمنت المعاملات طرازين وراثيين من الفول (BSI و UPSI) ، وخمس كثافات نباتية (12.5 ، 25 ، 50 ، 100 و 200 نبات/م^2) . وقد سجلت أعلى نسبة معنوية من المساحة الورقية عند مرحلتي النمو (35-70 و 70 - 105 أيام بعد الزراعة) بكثافة 100 نبات/م^2 خلال موسم 1981/82 ، وبكثافة 25 و 50 نباتا/م^2 خلال موسم 1982/83 . كما ازداد دليل المساحة الورقية ومعدل النمو المحصولي ، وانخفض كل من معدل التمثيل الغذائي الصافي ومعدل النمو النسبي ، ومعدل النمو الورقي النسبي مع زيادة الكثافة النباتية في كل من مرحلتي نمو المحصول .

Agronomy and Mechanization

المعاملات الزراعية والمكننة

Comparison of Machinery Arrangement for Narrow Planting of Faba Bean

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Abstract

Different planter arrangements were compared in this experiment, i.e., two rows/ridge and three rows/ridge at the ridge widths of 60 and 80 cm. There were no significant differences ($P < 0.05$) in yield and yield components among all treatments. However, planting two rows on 80 cm wide ridges proved the best choice, especially because of its ease of operation and conformity with the current system of machinery use in Rahad Agricultural Project.

Introduction

Research on the mechanical planting of faba bean (*Vicia faba* L.) in Sudan is limited. Dawelbeit (1987) obtained satisfactory results from testing three planting machines i.e., Lilliston S200 Planter, Hestair Stanhay Jumbo Precision Planter (both are row planters), and Nordsten Seed Drill. However, mean yields were highest for the row planters.

As a continuation to the previous work, this study was undertaken to compare and evaluate different planter arrangements in sowing two rows and three rows/ridge on 80 and 60 cm wide ridges, and to examine any technical problems that may occur in adapting the planters to this system.

Materials and Methods

The experiment was conducted at the Rahad Research Station, El-Fau, Sudan during the 1986 season. The soil was vertisol with high clay content (50-60 %), low organic matter (0.03%) and alkaline pH (8.8-9.4) (Fahal 1984).

A Hestair Stanhay Jumbo Precision Planter was used in this experiment. The metering device was a belt type and openers were runner type. In addition there were front wheels for depth control and rear drive press wheels for covering. The machine was full-tractor mounted and equipped with a hydraulic assist wheel.

The faba bean cultivar BF 2/2 (100-seed weight 34 g, diameter 8-12 mm) was used in this experiment. Four treatments A, B, C and D comprising 2 and 3 rows on 80 cm wide ridge plus 2 and 3 rows on 60 cm wide ridge respectively, were tested in a randomized complete block design with four replications.

Seeds were sown on 2 Nov 1986 at a seed rate of 180 kg/ha. Furrow irrigation was made every 10 days up to flowering, and then at weekly intervals up to maturity. Superphosphate (43 kg P_2O_5/ha) was applied at sowing. As Rahad soils are poor in faba bean *Rhizobium*, the crop was fertilized with 86 kg N/ha as urea three weeks after sowing.

Data on crop emergence were collected from one-meter row samples at four places in each plot. Data for plant population and plant height were collected at 47 and 172 days after planting, respectively.

Planter arrangement

Narrow row seeding requires special arrangements. Three rows/ridge can be planted either by the double-toolbar arrangement (**Fig. 1**) or by using two runs on the same ridge with a single toolbar. Preliminary tests were done to see the effect of different planter sequences on ridge shape. **Fig. 2** illustrates the final shape of the ridge after two runs of a single toolbar. In **Fig. 2a** the center row was planted in the first run followed by the two outside rows in the second run. **Fig. 2b** shows the ridge shape when the two outside rows where planted in the first run followed by the center row in the second run.

In this experiment, a double toolbar could not be used due to the shape of the planter's toolbar. Hence the two runs approach was followed for planting three rows/ridge, with the two outside rows being sown first and the center row sown on the second run.

For planting two rows/ridge (Treatments A and C) no practical problems were encountered except for 60 cm ridges (Treatment C), where the distance between the planter bodies was narrow for repairs and maintenance operations.

Results

Emergence: Mean emergence dates (MED), percentage of emerged seedlings (PE), and emergence rate index (ERI) were calculated as described by Bilbro and Wanjura (1982). MED is an indicator of time taken for emergence. ERI is an indicator of over-all emergence--the higher the ERI the better the emergence.

The results of this study show that there were no significant differences ($P < 0.05$) between the four treatments as far as MED was concerned (**Table 1**). Higher PE values were observed in the three-row treatments (**Table 1**). Treatments B and D had PE of 92.9 and 89.0, respectively, whereas the values for treatments A and C were 69.4 and 60.5, respectively. ERI values in this experiment ranged from 1.8 - 2.1. However, there were no significant differences ($P = 0.05$) among the four treatments (**Table 1**).

Plant population: Plant population ranged from 26.6 to 40.9 plants/m^2. The highest stand was obtained with 3 rows/ridge on 80 cm wide ridges (Treatment A), whereas the lowest was obtained with 2 rows/ridge on 80 cm wide ridges (Treatment B).

Yield: Yield and other parameters, i.e., pods/plant, 100-seed weight, and plant height are shown in **Table 1**. Seed yield ranged from 1302.1 to 1114.6 kg/ha. But, there were no significant differences ($P < 0.05$) among the four treatments. Also, there were no significant differences in pods/plant, 100-seed weight, and plant height among all the treatments.

Discussion and Conclusions

In reviewing the literature, it was noticed that in the majority of agronomic research, results and recommendations were only applicable when operations, especially planting, were manually performed. However, when machinery is introduced to perform these operations, more factors are added and other problems may be encountered. These factors and problems may lead to

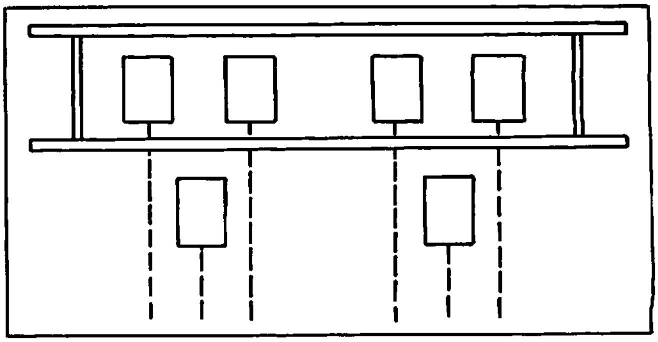

Fig. 1. Top view of double toolbar arrangement.

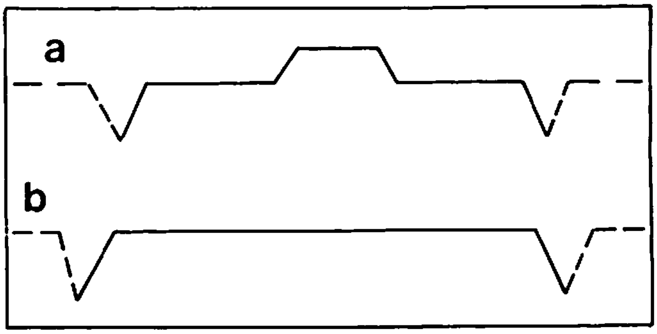

Fig. 2. Final shape of the ridge after planting (a) the center row in the first run and the two outside rows in the second run; (b) the two outside rows in the first run and the center row in the second run.

Table 1. Comparison of effect of various machinery arrangement treatments for narrow mechanical planting of faba bean on the plant emergence, growth, and yield of faba bean.

Attributes	Row width				
	80 cm		60 cm		
	Rows/ridge		Rows/ridge		SE
	2	3	2	3	±
	A	B	C	D	
Emergence					
MED	10.3	10.1	9.9	10.3	
PE	69.4	92.9	69.5	89.0	
ERI	1.8	2.1	1.8	1.9	
Population (plants/m^2)	26.0	40.9	32.0	38.8	
Pods/plant	5.8	6.4	5.9	5.5	0.24
100-seed weight (g)	26.6	25.2	26.2	26.0	
Plant height (cm)	72.4	78.4	71.2	68.5	4.2
Yield (kg/ha)	1302.1	1224.0	1250.0	1114.6	80.0

changes in the results and recommendations initially designed for manual operations.

Ageeb (1985) reported that faba bean seed yield was significantly increased when row spacing was decreased from 60 to 40 and from 40 to 20 cm. Salih (1985) also concluded that the yield of faba bean in Shambat area of Sudan could be increased by increasing the number of rows/ridge to three, in contrast to a single or double row pattern of seeding on ridges 60 cm apart.

In this experiment, the differences were not significant between the two and the three rows/ridge at 80 or at 60 cm wide ridges. However, it was observed that planting machines could be easily operated on two rows/ridge at 80 cm wide ridges. The standard ridge width used in the Rahad Agricultural Project is 80 cm. Therefore, the use of two rows/80 cm wide ridges is recommended for machine planting in this region.

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مقارنة عدة تعييرات لبذر الفول على مسافات ضيقة

ملخص

في هذه التجربة قورنت عدة تعييرات للبذارة لبذر صفين/الظهر (الثلم) ridge وثلاثة صفوف/الظهر ، بعرضين للظهر قدرهما 60 و 80 سم • ولم تظهر ثمة فروق معنوية (بمستوى 5 %) في الغلة ومكوناتها بين جميع المعاملات • إلا أن زراعة صفين على ظهر عريض (80 سم) أثبتت أنها أفضل خيار ، وخاصة لأنها تسهل عمليات الخدمة وتلائم نظام المكننة الزراعية السائد حاليا في مشروع رهد الزراعي •

Performance of Faba Bean and Other Food Legumes in Northern Madhya Pradesh, India

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Abstract

The yield, days to flowering, days to maturity of five faba bean (*Vicia faba* L.) genotypes along with one variety of each of conventional *rabi* legumes (chickpea, lentil, and pea) were studied on farmers' fields. All the faba bean genotypes yielded significantly higher than the other three crops and matured 17 days earlier. Thus, faba bean appears to be a good alternate crop to the other *rabi* legumes in northern Madhya Pradesh.

Introduction

In Gwalior, Bhind, and Morena districts (26°N latitude) of northern Madhya Pradesh where alluvial soils (inceptisal or entisal) are dominant, the conventional *rabi* legumes namely chickpea (*Cicer arietinum* L.), pea (*Pisum sativum* L.) and lentil (*Lens culinaris* M.) are generally grown under rainfed conditions. However, with the increased irrigation facilities in these districts, the area and consequentially the production of these three crops are decreasing. This situation necessitates the search for an alternate food legume. Farmers in this region are now showing more interest in the cultivation of faba bean, mainly because of its increased consumption in the human diet (green vegetable) and animal feed. Therefore, the present work was initiated to compare the yield, days to flowering, and days to maturity of five faba bean genotypes with those of chickpea, pea, and lentils to assess the feasibility for the incorporation of faba bean in the prevailing cropping systems and its economic competitiveness with other crops.

Materials and Methods

Five faba bean cultivars (JV 33, G_7, JV 10, JV 1, and local) along with a commercial cultivar of chickpea

Table 1. Mean seed yield, days to flowering, and days to maturity of faba bean, chickpea, pea, and lentil in northern Madhya Pradesh, India during the 1984-86 seasons.

Variety/crop	Yield[1] (kg/ha)			Days to Flowering	Days to Maturity
	1984/85	1985/86	Mean		
Faba bean					
JV 33	3022.6	2775.7	2899.2	66	136
JV 7	2927.9	2881.4	2904.7	57	135
JV 10	2979.0	2804.3	2891.7	56	140
JV 1	2927.7	2700.7	2814.2	55	136
Local	2963.0	2751.4	2857.2	57	142
Chickpea	2575.7	2237.1	2406.4	70	155
Lentil	1795.7	1792.9	1794.3	55	138
Pea	1725.1	1831.4	1778.3	65	156
SE +	39.9	177.7	63.2		
LSD (5 %)	110.6	492.5	172.4		

1. A number of farms within a year were treated as replication for statistical analysis.

(K850), field pea (JM 1), and lentil (Masoora) were grown for two successive seasons on farmers' fields in northern Madhya Pradesh. Seven fields were chosen to represent different soil variations (sandy loam to clay loam) in each year. Thus, a total of 14 different farms were covered in the two years of experimentation. Each crop was sown, with the bullock-drawn seed drill, in plots (250 m^2 each) with row spacing of 30 cm using the recommended seed rate. A dose of 100 kg/ha diammonium phosphate was applied before sowing.

Results

All the faba bean genotypes yielded significantly higher than the other three conventional *rabi* legumes, however, there were no significant differences among the five faba bean genotypes (**Table 1**). Chickpea came second highest and yielded significantly higher than lentil and field pea. **Table 1** also indicates that total days to maturity in faba bean were about 17 days less than those required by chickpea and peas, and nearly the same as for lentil.

From the results of this study, it is evident that faba bean is a good alternate crop to the other *rabi* legumes in northern Madhya Pradesh.

كفاءة الفول والبقوليات الغذائية الأخرى
في شمالي مدهايا برادش بالهند

ملخص

دُرست في حقول المزارعين كل من الغلة ، وعدد الأيام حتى الأزهار ، وعدد الأيام حتى النضج لخمسة طرز وراثية من الفول (Vicia faba L.)،مع صنف واحد من كل من البقوليات الشتوية (حمص وعدس وبازلاء) . وقد أعطت جميع طرز الفول غلة أعلى معنويا من غلال البقوليات الثلاثة الأخرى ، ونضجت أبكر منها بـ 17 يوما . وهكذا يبدو أن الفول هو بديل جيد من محاصيل البقوليات الشتوية الأخرى في شمالي مدهايا برادش بالهند .

Pest and Disease

الآفات والأمراض

Effect of Sowing Date on Orobanche crenata Infestation in Vicia faba in Egypt

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Abstract

Attachment and early development of *Orobanche crenata* Forsk. on two Egyptian cultivars of *Vicia faba*, (Giza 2 and Giza 402) was studied in the field following six different sowing dates during the period Oct - Dec 1985. Observations were recorded on plants dug up with an intact root system at weekly intervals, beginning 4 - 6 weeks after sowing (WAS) until 10 WAS. New parasite attachments developed during the whole winter period; minimum air temperatures never being below 5°C, the seed germination of the parasite must have continued in the soil. Attachments were less on host plants of later sowing date, with the exception of the last sowing date when the number seemed to increase again. Cultivar 'Giza 2' flowered slightly earlier than 'Giza 402'. Parallel to that, *Orobanche* attachments and stalk emergence occurred earlier in Giza 2 than in Giza 402. The mechanism behind this correlation deserves further study. The number of spikes/attachment ranged from 1-8 indicating that there was more than one spike/tubercle, unlike what is usually mentioned in the literature.

Introduction

In various regions around the Mediterranean Sea and in the Middle East, the parasitic weed *Orobanche crenata* Forsk. (crenate broomrape) causes considerable losses in the yield of *Vicia faba* L. However, later sowing has been found to lead to a decrease in *Orobanche* infestation (Cubero and Moreno 1979; Cubero 1983; Nassib *et al.* 1984; Kukula *et al.* 1985; Mesa-Garcia and Garcia-Torres 1982, 1986; Arjona-Berral *et al.* 1987) Hezewijk *et al.* 1987; Sowing date experiments in Syria (Hezewijk *et al.* 1987) showed no attachment of parasite to faba bean during the coldest period and there was an extension of the period between sowing and the first *Orobanche* attachment with later sowing. Similar results were obtained in Spain by Mesa-Garcia and Garcia-Torres (1982, 1986) and Arjona-Berral *et al.* (1987). While these authors did not indicate a relation between the development of *Orobanche* and phenology of the host, Kadry and Tewfic (1956) reported that *O. crenata* always germinated one week before flowering of faba bean, irrespective of the sowing date. Zahran (1982) had the same view because he believed that the release of the germination stimulant occurred just before and during flowering.

The present study conducted simultaneously with the study of Hezewijk *et al.* (1987) in Syria, was concerned with the early phases of development and growth of *O. crenata* in Egypt. The aim was to investigate whether the higher winter temperatures in Egypt, as compared to those in Syria, have a different effect on *Orobanche* development after delayed sowing.

Materials and Methods

The local faba bean cultivars 'Giza 2' and 'Giza 402' were sown on the Experimental Farm of the Agricultural Research Centre at Giza, Egypt, on a plot naturally infested with *O. crenata*. The beans were hill sown on six dates (13 Oct, 27 Oct, 10 Nov, 25 Nov 1985, 10 Dec and 22 Dec 1986) in 6 x 6 m^2 plots with the distance between rows 0.60 m and distance between hills 0.30 m. Two beans were planted/hill. The plots were irrigated about once every three weeks. There were three replicates for each treatment.

There were five weekly samplings starting four weeks after sowing (WAS) in the 27 Oct sown crop and six WAS in the crops of all other sowing dates. Usually four hills/plot were sampled, but the number varied from one to five. A total of about 1000 bean plants with their parasites were studied.

On each sampling date the following data were collected for *V. faba* shoot: length of the main stem, fresh and dry weight, and leaf area which was measured using a Licor model LI 3050A, stage of development according to Stuelpnagel (1984). *V. faba* root: length of the main root and fresh and dry weight. For *O. crenata*: number of attachments and number of buds or spikes/attached plant, diameter, dry weight taking the parasites attached to one host plant together, and stage of development of the *Orobanche* plants, using the following scale;

1 = young tubercle
2 = tubercle with beginning crown roots
3 = one or more spikes longer than 1.0 cm
4 = spikes developing,
  a) spikes at least 2.5 cm
  b) spikes more than 5 cm, i.e. emerged or about to do so.

The roots were studied with a binocular microscope, and the smallest tubercle recorded was about 1 mm in diameter.

On three dates, 19 Dec 1985, 27 Jan, and 1 Mar 1986 the number of emerged spikes was counted in all plots. At this stage a distinction was made between spikes in bud and spikes in flower, designated as 5a and 5b, respectively.

Results and Discussion

It appeared that the area which was used for the experiment was not uniformly infested. The *Orobanche* infestation was markedly lower in one half than in the other half of the field where many plants remained uninfested. Moreover, in several cases, the number of bean plants/hill was not two, as had been the objective, but one or three. As a consequence, the data allow a qualitative analysis, but few quantitative conclusions.

Development of *Vicia faba*

When sampling was started (6 WAS) faba bean plants of all sowing dates had developed flower buds, and half of the plants of the first sowing date (13 Oct 1985) had started to flower. In general it can be concluded that with delayed sowing, faba bean plants required more time to flower, but at the same time the period between bud formation and pod development was reduced, i.e. development was quicker when sowing had been delayed (Borg 1987). Development of flower buds was later in Giza 402 than in Giza 2 (**Fig. 1a**). Comparison of uninfested plants with those infested (**Fig. 1b**) revealed that *Orobanche* retarded the development of its host.

Development of *O. crenata*

There was a continuous increase in attachment and subsequent emergence of *Orobanche* during the entire period of observation. The day temperatures in this period were not below 20^{o}C, and those during the night not under 5^{o}C. Thus the soil temperatures did not fall below 8^{o}C, the reported minimum for *O. crenata* germination (Kasasian 1973). By the first week of March, *Orobanche* infestations in stage 1-3 were found on plants from all sowing dates, and spikes had emerged on plants from all sowing dates except the sixth.

The period between sowing and first *Orobanche* attachment increased when sowing was delayed, and varied from 4-7 weeks. The first crown roots began to develop after 5-9 weeks, and spikes began to grow 7-10 WAS. For sowing date 13 Oct 1985, the first spikes emerged 9 WAS, and for the other sowing dates spikes started to appear 10 WAS. The length of the period between attachment and emergence was similar for all sowing dates; unlike in *V. faba* there was no making up arrears (Borg 1987).

Faba bean plants which were sown on 13 Oct 1985 showed a sudden increase in the number of new attachments during the 10th WAS. This may be due to the germination of *Orobanche* seeds stimulated by exudates from newly developed roots or because of interaction with other *Orobanche* attachments. The number of attachments decreased with later sowing. However, the data for the latest sowing date (22 Dec 1985) suggest a slight increase (**Fig. 2**). A similar decrease in the number of attachments was reported in Syria by Hezewijk *et al.* (1987). These authors suggested, in accordance with Mesa-Garcia and Garcia-Torres (1982, 1986) in Spain, that the number of *Orobanche* attachments decreased as a result of the low temperatures during the winter season, and they also attributed the increased number of infested plants from the latest sowing date to the slightly higher temperatures in late winter/early spring. The same might hold for the Egyptian situation, but it should also be noted that observations in Egypt were stopped 10 WAS, i.e., at a

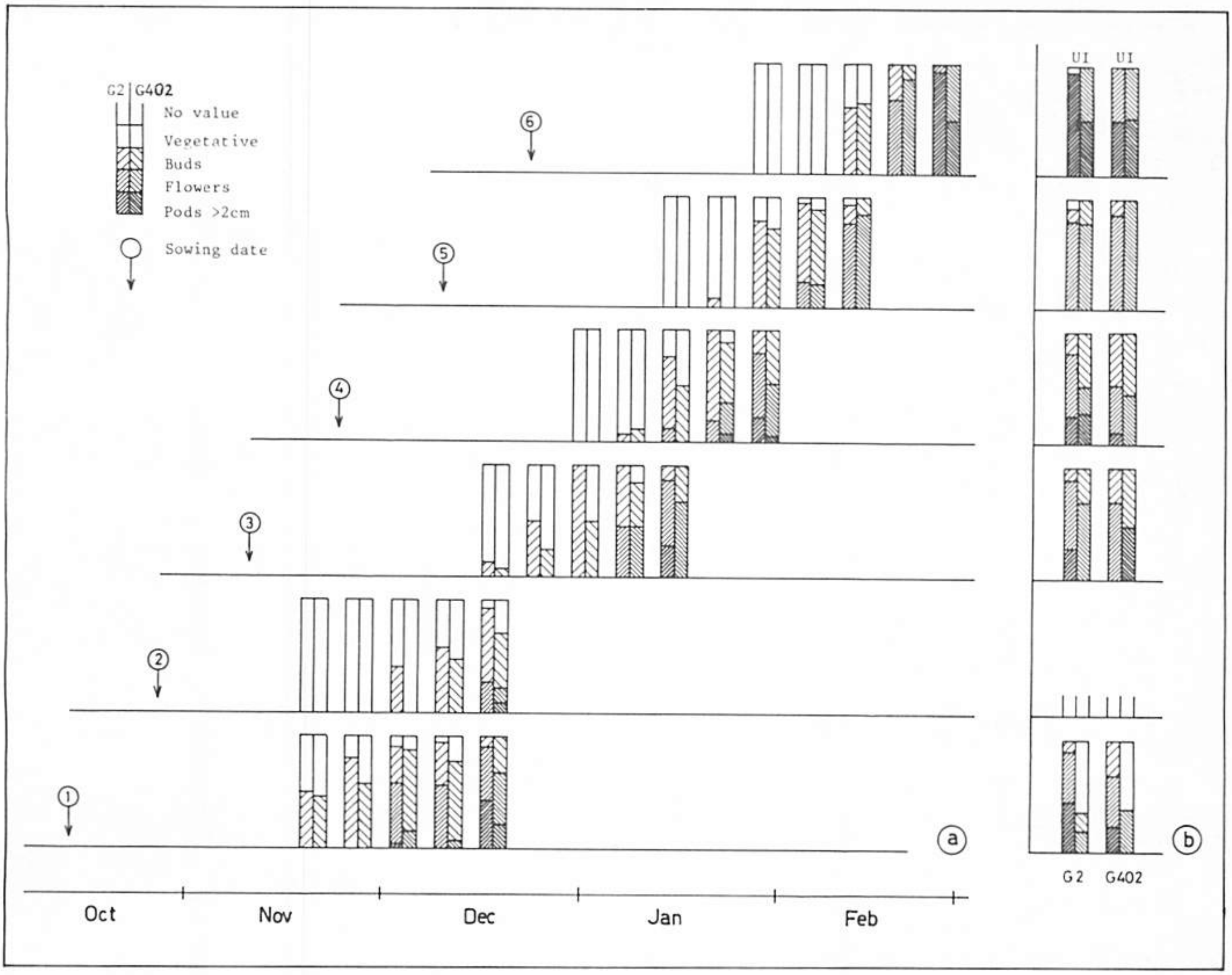

Fig. 1. Development of V. faba with time in each sowing date. (a) Uninfested plants of Giza 2 (left) and Giza 402 (right) sown on various dates; proportion of plants in a certain stage development, and (b) comparison of the developmental stage of infested (I, right) and uninfested (U, left) plants of the fifth sampling.

moment when germination and attachment had not been fully completed for all sowing dates.

Fig. 3 shows that *Orobanche* attachment was earlier with Giza 2 as a host than with Giza 402. This was less conspicuous for the intermediate sowing dates. The difference persisted during the development of the parasite, as is demonstrated by the fact that *Orobanche* spikes on Giza 2 emerged before those on Giza 402 (**Fig. 2**, columns at the right).

A close observation of the plants showed that in many cases, more than one spike developed from a single tubercle. Although this appears to be a common phenomenon in Egypt (El-Helaly *et al.* 1973; Habib 1978), authors elsewhere usually state that one spike emerges from a tubercle. **Fig. 4** presents some quantitative data on this point. There seems to be no difference for *Orobanche* plants on Giza 2 or Giza 402. A comparative study is required to see whether this character has a genetic basis and is limited to the Egyptian *O. crenata* populations or is more widespread. The question then may also be raised whether the spike number is influenced by environmental conditions, either abiotic (water, nutrients) or biotic (e.g. pathogens interfering with meristems or apical dominance).

Relation Between Parasite Development and Development of the Faba Bean

According to Zahran (1982) *O. crenata* only attaches to hosts in the flowering stage because non-flowering

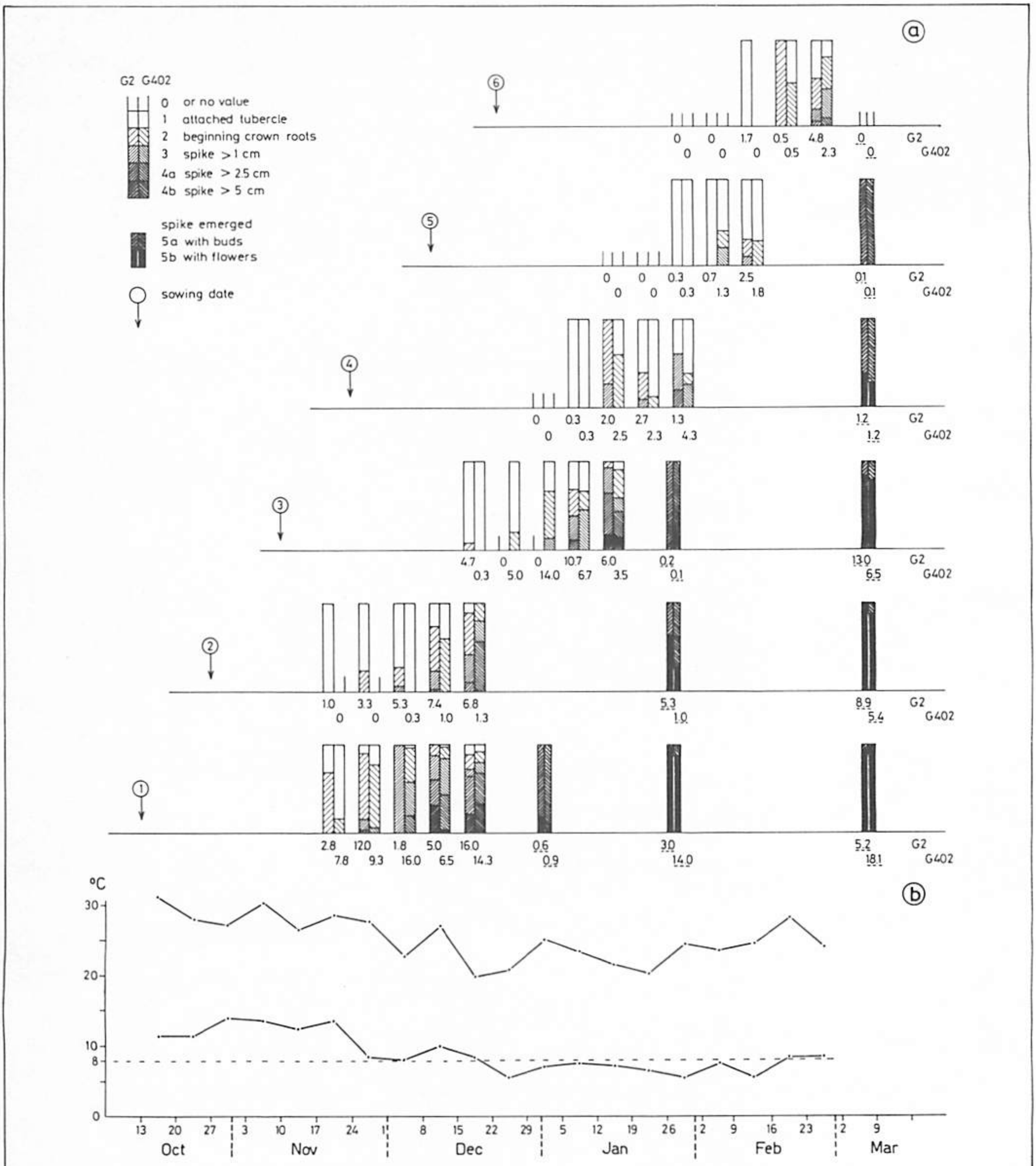

Fig. 2. Development of O. crenata with time in each sowing date of faba bean (a) proportion of Orobanche in a certain stage of development in Giza 2 (left) and Giza 402 (right). The broad colums concern all attached Orobanche plants; the narrow columns show only emerged spikes. The average numbers of either attachments or spikes per hill are given under each column. Due to the inhomogeneity of the infestation in the experimental field numbers within a variety can be compared, but numbers cannot be compared between varieties. (b) Minimum and maximum air temperatures observed during a certain week.

plants do not release a germination stimulant. In contrast, we found in a few cases that plants without any buds or flowers had been infested, which indicates that the production of germination stimulants is not absolutely restricted to the flowering stage. This is in accordance with observations by Mesa-Garcia and Garcia-Torres (1982, 1986), and Arjona-Berral *et al.* (1987) in Spain, and Hezewijk *et al.* (1987) in Syria. Consistent with the observations of these authors, we also found that parasite attachment could occur in all later stages of development of the host (**Table 1**), suggesting that there is little or no relation between the phenological stage of the host and germination or attachment of the parasite. However, the differences observed in the development of *Orobanche* on Giza 2 and Giza 402 indicate that there is still a relation between the moment of attachment and the stage of development of the host: Giza 2 was earlier to flower, was attacked earlier (**Fig. 3**), and had earlier emergence of *Orobanche* spikes than Giza 402 (**Fig. 2a**). The differences are, however, small and clearly need further testing, although they are supported by the observations of Kadry and Tewfic (1956) who noticed a correlation between the start of flowering of the host and the germination of the parasite. The phenomenon and its physiological basis deserve further study.

Hezewijk *et al.* (1987) found a relationship between the number of attached parasites and host root weight at

Table 1. Numbers of young tubercles of *O. crenata* (stage 1) on *V. faba* plants (Giza 2 and Giza 402 taken together) at various developmental stages; numerical description of developmental stage of faba bean according to Stuelpnagel (1984).

Stage of development of faba bean		Sowing date				
		13 Oct	27 Oct	10 Nov	10 Dec	22 Dec
Vegetative	25			1		
	27		3			
Buds	53	30	22	19	4	
	57	18	4	8	8	
Flowering	61	9	13	8	5	
	63	5		4	5	
	65	4			1	
	67				5	3
	69					4
Pods ≥ 2 cm	72	1			3	1
	74					3

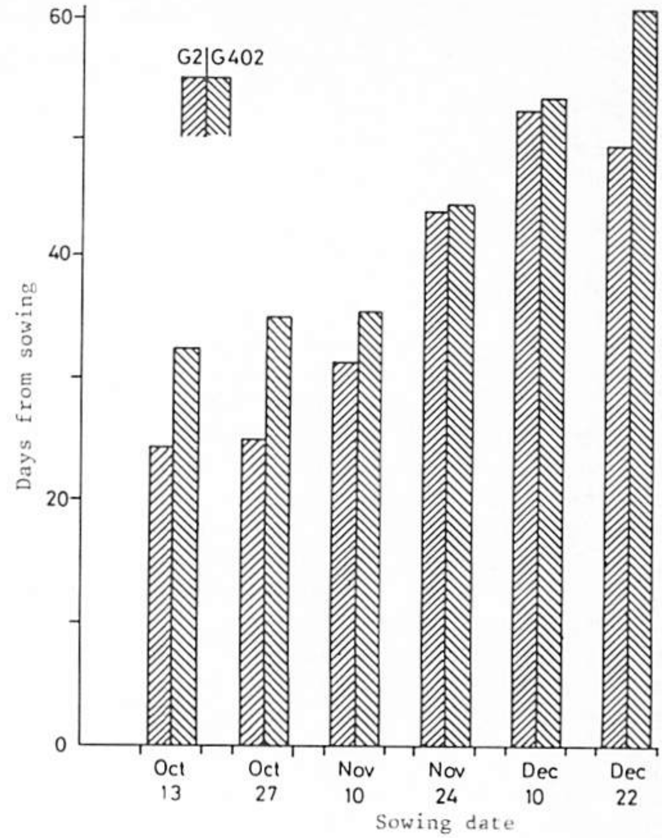

Fig. 3. Number of days from sowing until first attachment of O. crenata on Giza 2 (left) and Giza 402 (right).

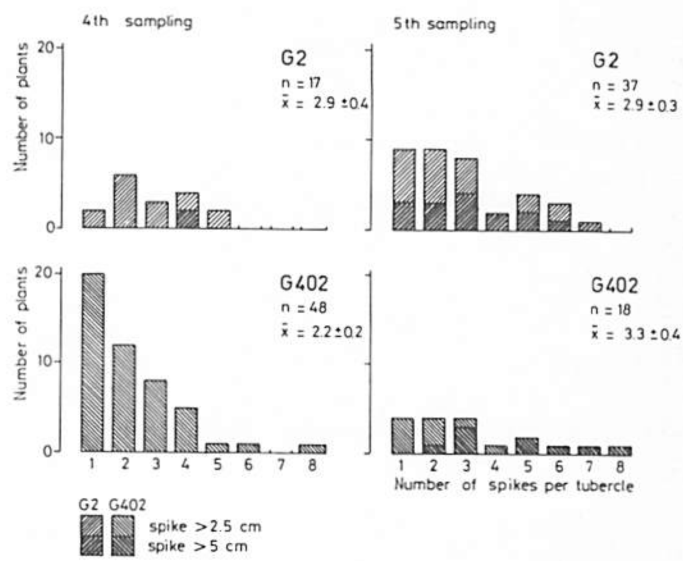

Fig. 4. Variation in the numbers of spikes/tubercle of Orobanche crenata. Data concern plants of the first sowing date (13 Oct 1985) and fourth and fifth sampling respectively. Average number ± SE.

harvest. It explained to some extent the decrease of numbers with later sowing date, and also the differences in numbers of attachments on the two cultivars included in their experiments. We could not test this relationship, because in the present study the observations were stopped long before harvest.

Conclusions

The data on the relationship between the development of *O. crenata* and *V. faba* and their variation with sowing date are comparable to those presented for other areas by other authors, except for the germination and attachment during the winter season, when temperatures in Egypt apparently were high enough for these processes to continue. The numbers of attachments decreased with delay in sowing up to a point, as also reported by other authors.

Though attachment appeared to be a continuous process once it had started, it was also observed that its start was related in some way to the time when flowering of *V. faba* began. This observation is supported by data from other studies in Egypt, but seems to differ from that reported for other areas. A further study of the relation between temperature, phenology of faba bean, and the development of *O. crenata* therefore seems to be justified.

And finally, the data on numbers of spikes per attachment revealed that the relation between numbers of emerged spikes and sub-soil processes, including those on host-resistance, should be watched with care.

Acknowledgments

We like to thank Dr. Hamdi Aziz (Giza) and Mr. Frank Roorda (Amsterdam) for their help and advice in conducting the experiments, and Mr. Herman Klees (Wageningen) for preparing the figures. Two of us (D. Raaimakers and J. Raaijmakers) conducted the experiments as part of our study in biology at the University of Utrecht. Financial support was received from the Utrecht University Fund, and logistic help from ICARDA-Cairo. The project was further funded by the European Community (EC) under EUR-contract no. TSG-A-187-NL.

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تاثير موعد الزراعة على إصابة الفول بالهالوك المفرض Orobanche crenata في مصر

ملخص

درست في الحقل بوادئ تطفل الهالوك المفرض Orobanche crenata Forsk. وبداية تطورها على صنفين مصريين من الفول Vicia faba هما (جيزة 2 وجيزة 402) ، وذلك من خلال دراسة ستة مواعيد زراعة مختلفة في المدة من تشرين الاول/نوفمبر ــ كانون الاول/ديسمبر 1985 . وقد سجلت قراءات على نباتات تم اقتلاعها بالحفر بمجموعها الجذرى السليم بفواصل أسبوعية بدءا من 4 - 6 أسابيع بعد الزراعة وحتى 10 أسابيع . وقد نمت بوادئ تطفل جديدة على امتداد فصل الشتاء عندما لم تهبط درجة حرارة الهواء مطلقا إلى ما دون 5° م، وبذا فإن عملية إنبات بذور الطفيل قد استمرت في التربة . وكانت بوادئ التطفل أقل على النباتات العائلة المزروعة في موعد متأخر باستثناء الموعد الأخير عندما أخذ عددها يزداد ثانية. وقد أزهر الصنف جيزة 2 قبل جيزة 402 بفترة وجيزة . وعلى نحو مشابه كان ظهور بوادئ التطفل وانبثاق الساق في الصنف جيزة 2 أبكر مما هو في الصنف جيزة 402، وهذه الآلية الكامنة وراء هذا الارتباط جديرة بمزيد من الدراسة . وقد تراوح عدد الرؤوس الزهرية/بادئة التطفل بين 1 ــ 8 ، مما يشير إلى أنه كان هناك أكثر من رأس/البصيلة ، وهذا يخالف ما تذكره المراجع عادة .

Some Factors Affecting Rhizosphere Fungi Populations of Faba Bean Roots

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Abstract

In a series of pot experiments in a glasshouse, rhizosphere fungi of faba bean cultivars at different stages of growth were studied, and their effects with the root-rot fungus Rhizoctonia solani, cultivar, crop residue, and fungicidal seed dressing were also determined. Inoculation with R. solani increased the fungi populations, where the highest counts were found at the vegetative and flowering stages. Cultivar Rebaya 40 seemed to stimulate rhizosphere fungi. Soil previously sown with soybean contained a higher number of rhizosphere fungi than that previously sown with maize or rice. Seed treatment with vitavax 200 and/or topsin 70 reduced the number of fungal colonies, but only during the first month of plant growth.

Introduction

Microorganism populations associated with rhizosphere of plant roots have been studied by many investigators. Habib (1979), found that within the same crop, the number and type of microorganisms is greatly variable. This variation has been attributed to several factors: environmental conditions and season (Katznelson and Chase 1944; Brown and Biol 1978); soil type and soil moisture relations (Clark 1942); cultivar (Habib 1979); plant age (Banerjee *et al.* 1958); application of fungicides, herbicides, or nutrients to the plant (Venkataram 1960), and diseases affecting the shoot or root systems (Lakshmi 1964).

In this investigation, we studied the microflora at root-soil interface of faba bean plants at various stages of growth. The object was to study the effects of infestation with *Rhizoctonia solani*, fungicidal seed dressing (vitavax and topsin), crop residue, and cultivars of faba bean on rhizospheric fungi.

Materials and Methods

Pot experiments were conducted in a glasshouse at Giza Agricultural Research Station. In all experiments, except for the control, soil was artificially infested (10 days before planting) with *Rhizoctonia solani* (previously grown on barely-sand medium for a week) at the rate of 5% of soil weight. Four pots (20 cm in diameter) with 3 seeds/pot were used for each treatment.

Effect of faba bean cultivar

Seeds of four faba bean cultivars, Giza 402, Giza 1, Giza 2, and Rebaya 40 were sown 10 days after soil infestation with *R. solani*. Fungal populations in the rhizosphere were counted at 30-day intervals from planting till maturity (i.e., 30, 60, 90, and 120 days, which relatively correspond to seedling, vegetative, flowering, and maturity stages of the plant). For determination of rhizosphere fungi the dilution plate method was used. Plants were carefully uprooted (at 6-7 a.m.) and were brought to the laboratory immediately. Samples (2 g each) of fresh roots with adhering soil particles were taken from each replicate. Each sample was placed in weighed conical flask containing 100 ml of sterilized distilled water. The flasks were shaken for 30 min using a mechanical shaker to obtain maximal dispersal without damaging the organisms. The suspension was diluted and poured onto Martin's medium

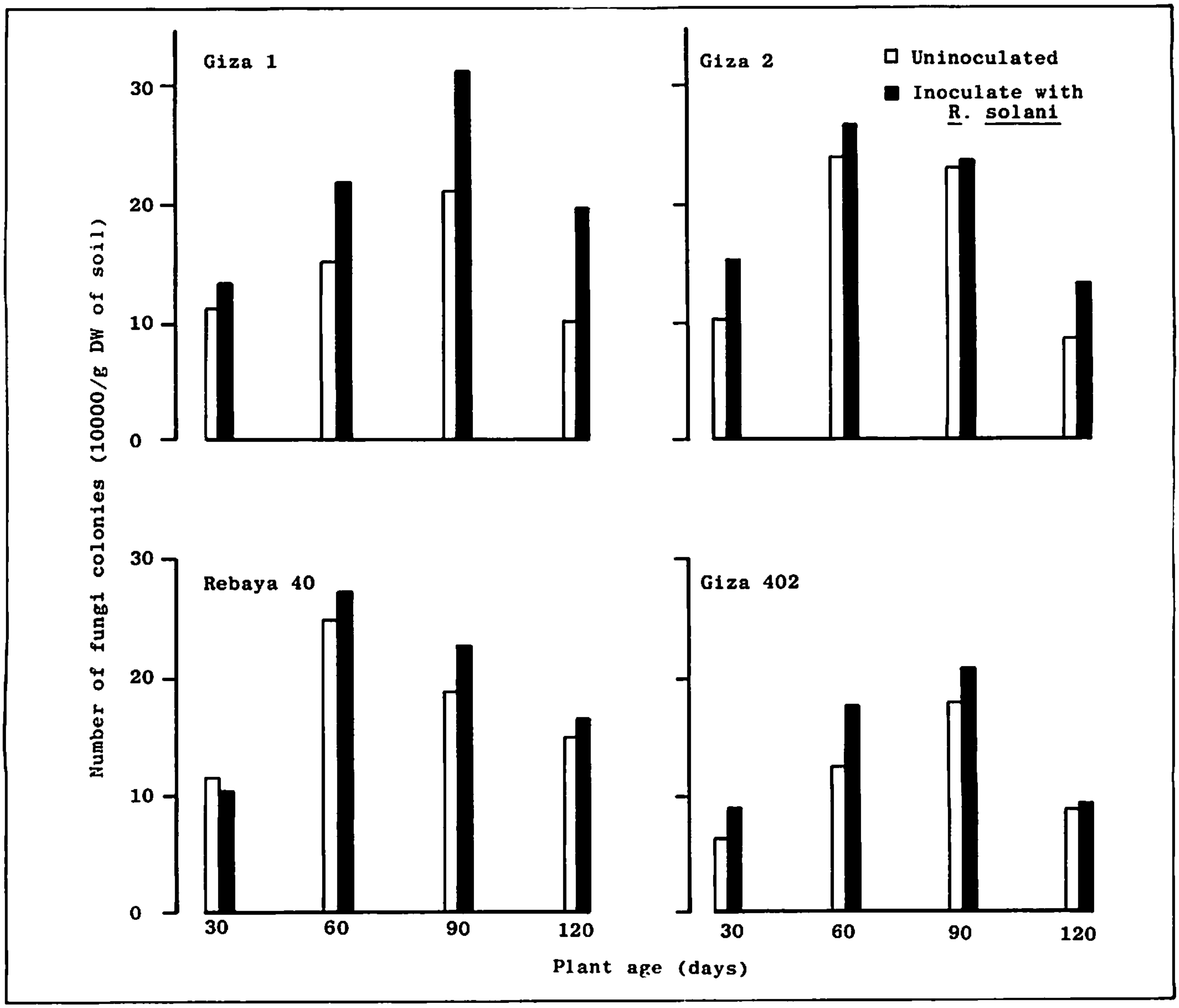

Fig. 1. Effect of four faba bean cultivars on rhizosphere fungi populations at different stages of plant growth. LSD ($P<0.05$) for main effects of cultivars (C), plant age (A) and C X A interaction were 1.7, 1.8, and 3.4, respectively.

(Martin 1950) in sterilized Petridishes; the dilution used was 1: 10,000. The plates were then incubated at 22 ±2°C and the fungal colonies were counted after 7-10 days.

Effect of crop residue

Soils previously sown with soybean, maize, and rice were used for this test. Nile clay was used as a control. Seeds of Giza 2 (commercial cultivar) were sown in infested and uninfested soils. For determination of fungal populations of the rhizosphere, samples were also taken at 30-day intervals.

Effect of fungicides

Giza 2 seeds were treated with vitavax 200 or topsin 70 at the recommended rate (2 g/kg seed). Treated and untreated seeds (control) were sown in infested and/or uninfested soils. Sampling was made at 15-day intervals and rhizosphere fungi were determined.

Results

Numbers of rhizosphere fungi varied among the four faba bean cultivars (**Fig. 1**). The fewest fungi numbers were

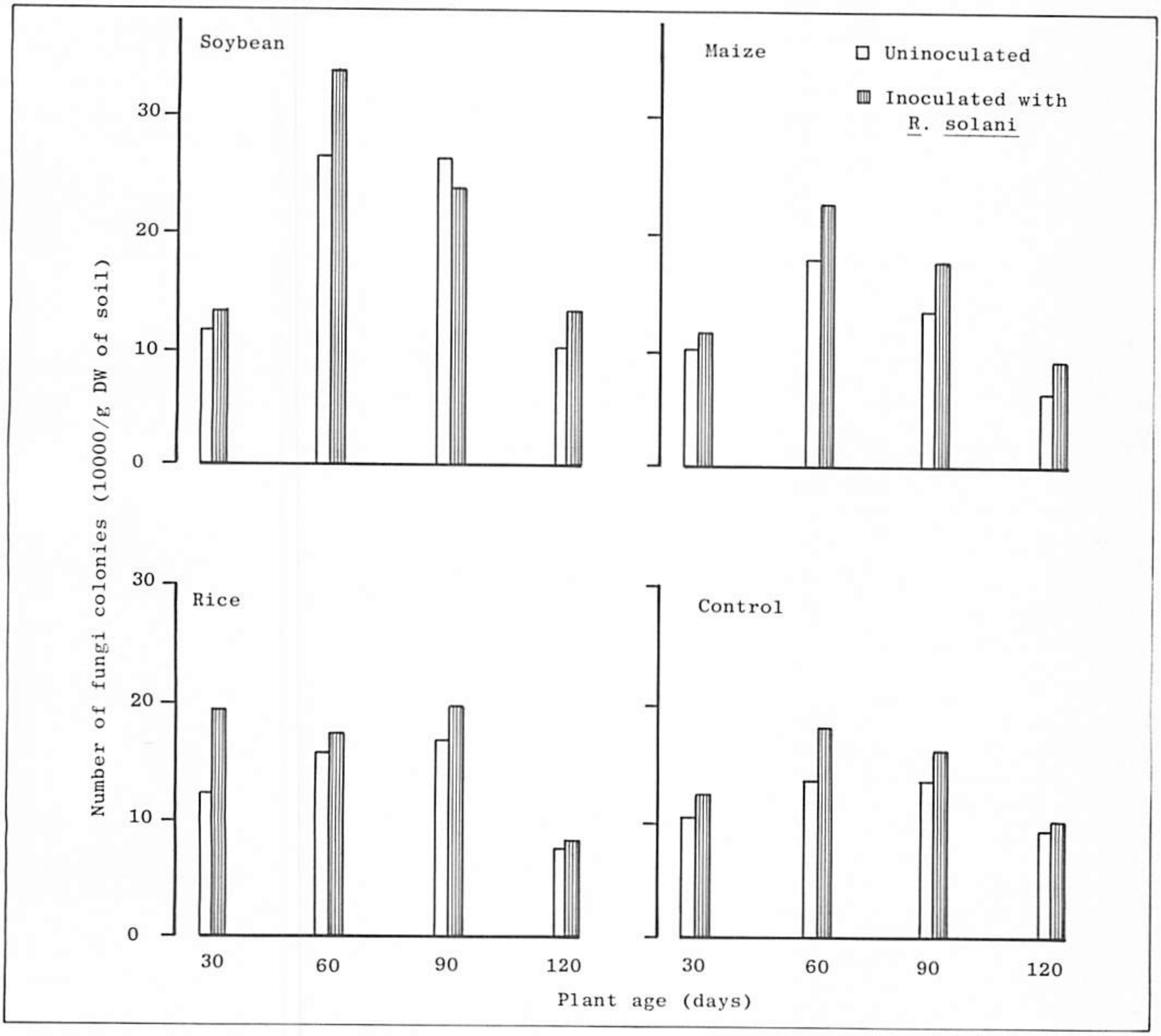

Fig. 2. Effect of crop residue on rhizosphere fungi populations of Giza-2 cultivar at different stages of plant growth. LSD ($P<0.05$) for main effects of crop residue (R), plant age (A), and R X A interactin were 3.9, 4.1, and 5.7, respectively.

found in Giza 402 cultivar. Inoculation with *R. solani* had significantly ($P < 0.05$) increased the number of fungi after 30 days from sowing; Rebaya 40 is the only exception among the four cultivars used in this experiment as there was little difference between the infested and uninfested treatments in this cultivar.

In general, fungal populations at vegetative and/or flowering stages (60 and 90 days from sowing) were highest followed by those at seedling and maturity stages (30 or 120 days from sowing).

Differences in the numbers of fungi in the rhizosphere of faba bean plants grown in soils previously cultivated with different crops were clear (Fig. 2). The highest counts were found in soil previously sown with soybean followed by that previously sown with maize or rice.

Treatment with vitavax 200 and/or topsin 70 reduced the number of rhizosphere fungi compared with the control (Fig. 3). However, this effect was only evident after 15 and/or 30 days from planting.

Discussion

Faba bean grown in soils inoculated with *Rhizoctonia solani* caused a significant increase in rhizosphere fungi. This could be attributed to the increased permeability of the cell wall of infected plant tissues, which may enhance the build up of rhizosphere micro-organisms (Beute and Lockwood 1968). Although the four faba bean cultivars used in this experiment vary in their degree of susceptibility to *R. solani* (Mohamed *et al.* 1982), the differences detected in the counts of rhizospheric fungi were small.

Variation in the numbers of rhizosphere fungi over the period of the experiment was related to plant age. The highest numbers were detected at vegetative and flowering stages. This is not surprising because the plants at these stages reach the maximum vigour, and the efflux of nutrients and other substances from the root system may be the reason for the build up of fungi populations in the rhizosphere. El-Said *et al.* (1978) found that in peanut plants the count of rhizosphere fungi was highest in the vegetative and lowest at maturity stages of plant growth.

The highest populations of fungi were found in soil previously sown with soybean followed by those previously sown with maize and rice. This is in agreement with the findings obtained by Omar (1985),

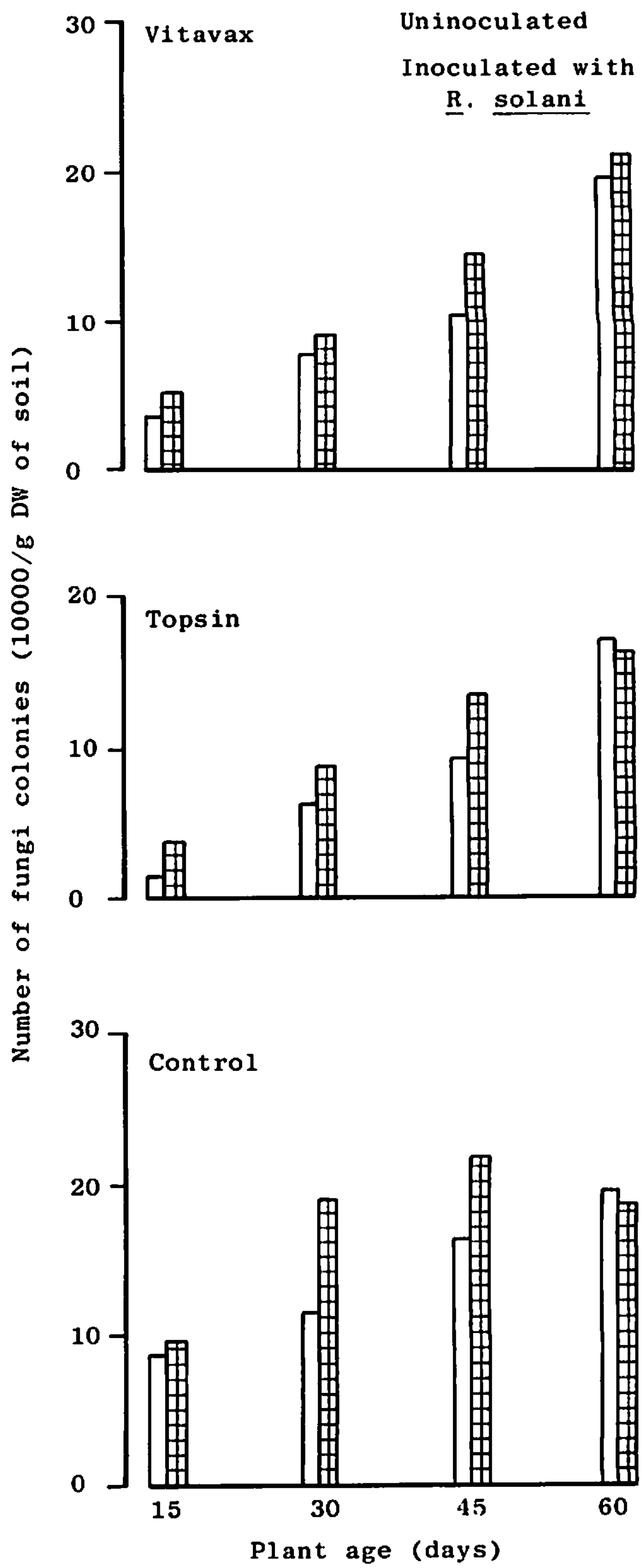

Fig. 3. Effect of fungicides on rhizosphere fungi populations of Giza 2 cultivar at different stages of plant growth. LSD ($P < 0.05$) for main effects of fungicides (F), plant age (A), and F X A interaction were 2.3, 1.2, and 2.4, respectively.

who reported that in faba bean fields, *R. solani* has a lower saprophytic competitive ability in soils previously planted with maize than with soybean. To minimize the impact of *R. solani* disease on faba bean yield, we suggest sowing faba bean after maize or rice rather than after soybean.

The effect of seed dressing with vitavax 200 and/or topsin 70 on fungal density was high, but it lasted only up to 30 days from planting. Differences in treated and untreated seeds after 45 days or more were negligible suggesting that the fungicides had been degraded by that time.

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بعض العوامل المؤثرة على عشائر فطور المحيط الجذرى لنباتات الفول

ملخص

ضمن سلسلة تجارب اصص في الدفيئة ، درست فطور المحيط الجذرى لاصناف فول في مراحل مختلفة من النمو ، وكذلك تأثيراتها حيال فطر تعفن الجذور Rhizoctonia solani. كما تم تحديد تأثير كل من الصنف ، وبقايا المحصول ، ومعاملة البذور بالمطهرات الفطرية على ذلك . وقد أدى التلقيح ب R. solani إلى تزايد عشائر الفطور ، ووجد أكبر عدد منها في طورى النمو الخضرى والإزهار . وبدا أن الصنف Rebaya 40 ينبه أو ينشط فطور المحيط الجذرى . كما وجد أن التربة المزروعة سابقا بفول الصويا تحتوى على عدد من فطور المحيط الجذرى أكبر من تلك التي كانت مزروعة بالذرة الصفراء أو الارز . أما معاملة البذور ب Vitavax 200 مع/او topsin 40 فادت إلى تقليل عدد المستعمرات الفطرية،إنما خلال الشهر الأول فقط من نمو النبات .

Seed Quality and Nutrition

جودة البذور والتغذية

Effect of Cooking Temperature and Time on the Hydration and Texture of Cooked Faba Bean "Medammis"

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Abstract

Six samples, three soft- (S) and three hard-to-cook (H), of freshly harvested faba bean seeds were simmered at 100°C for 8, 10, or 12h or autoclaved at 110, 115, 120, or 125°C for 1, 2, or 3h. Variation among samples of each group was mostly nonsignificant. Hydration coefficient (HC) of cooked beans was higher for 'S' than for 'H' samples. However, HC and moisture content were not appreciably affected by the different cooking temperatures and times, except that cooking at 120°C for 1h gave values less than those for other treatments. On the other hand, texture was highly affected by temperature and time of cooking. Beans with maximum shear force up to 100 kg/100g were acceptable to consumers. Texture of 'H' samples became acceptable by cooking at 115°C for 3h or at 120°C for 2h. Cooking 'S' samples at 120°C reduced the time to 12.5% of that required when cooking by simmering (1h at 120°C against 8h at 100°C) to achieve the same texture (about 86 kg/100g).

Introduction

In Egypt cooked faba bean, *Medammis*, is one of the most popular dishes. The traditional method for preparing this dish is by simmering the beans overnight (for 8 - 10 h at least) on a low fire.

Although several parameters are used to determine the cooking quality of faba bean (Shehata 1982), texture of cooked beans seems to be the most important sensory attribute which often determines quality and acceptability.

Morris *et al.* (1950) found that hardness in freshly harvested beans is associated with low water absorption capacity which was attributed mainly to impermeability of seed coat (hard-shell) and/or to inability of cotyledons to imbibe water (sclerema).

Besides other factors, several studies have shown that cooking time is mostly affected by temperature, and both time and temperature have a great effect on the quality of cooked beans. Morris *et al.* (1950) found that the cooking time for different varieties of dry beans at 115°C was 40% less than that at 100°C. Similarly, Silva *et al.* (1981) reported that cooking black beans (*Phaseolus vulgaris*) at 121°C reduced the cooking time to 30-40% of that required at 100°C, while Onayemi *et al.* (1986) found that cooking cowpea (*Vigna unguiculata*) in a pressure cooker at 121°C reduced the cooking time from 120 min (cooking in boiling water) to 100 min.

Rizley and Sistrunk (1979) found that boiled peas had lower shear press values than steam-cooked peas for the same time and temperature (100°C, 20 min). The effect of different temperatures and cooking times on certain properties of cooked faba beans was tested in this study, the aim being to determine the shortest cooking time required to give acceptable *Medammis* from soft- and hard-to-cook faba bean samples.

Materials and Methods

Several samples of freshly harvested faba bean seeds (1986 crop) were tested for their texture after cooking to obtain three soft-to-cook and three hard-to-cook samples.

Physical properties of dry seeds: For each sample 1000 seeds were weighed and their volume was measured by absolute displacement. One kg/sample was used for size grading using sieves with 8 mm round holes. The hydration and swelling coefficients (soaking for 2h at room temperature) were determined according to Hulse *et al.* (1977). Seed coat percentage was determined by removing manually the seed coats from 100g of seeds. All measurements were carried out in triplicate.

Characteristics of cooked beans: Faba bean samples were cooked by simmering (100°C) for 8, 10, or 12h (i.e., the traditional method) and also by autoclaving at 110, 115, 120, or 125°C for 1, 2, or 3h (the ratio between dry unsoaked seeds to distilled water was 1:3 except at 120°C, 3 h and 125°C, 2 h where a ratio 1:4 was used to compensate for evaporation losses). The hydration coefficient, moisture content (AOAC 1980), and texture (maximum shear force kg/100 g; Shehata *et al.* 1985) of cooked beans were determined in triplicate.

Sensory analysis (Sharp *et al.* 1986) for aroma, color, flavor, and texture was carried out on samples that were cooked by autoclaving to get a maximum shear force of about 55, 70, 85, 100, 115, and 140 kg/100 g. Twenty-seven panelists were asked to rate each sample according to its attributes as unacceptable (too weak), acceptable, or unacceptable (too strong). Each sample was also rated for overall impression as acceptable or unacceptable. The data were analysed using the Chi-Square method (Snedecor and Cochran 1967).

Results and Discussion

The physical properties of the dry faba bean seeds indicate significant variations between soft- and hard-to-cook samples (**Table 1**). Variations among samples within each group were mostly insignificant.

The properties of cooked faba bean samples varied insignificantly among the samples that belonged to each group (**Table 2**).

The effect of cooking temperatures and time on the moisture content and HC of cooked faba beans was very low except for cooking at 120°C for 1h. However, the 'H' samples had less moisture content and HC than the 'S' samples. The hydration of autoclaved samples occurred mostly during the first hour, followed by a slight increase during the second, and almost no change during the third (**Table 2**).

The effect of time and temperature of cooking on the texture of the cooked faba bean seeds was very conspicuous. Increasing the cooking time by 1h (for autoclaved samples) reduced the maximum shear force by 11.6% to 34.3% depending on the temperature. Cooking 'H' samples at 120°C and 125 °C for 2h, or at 115°C for 3h softened their texture to the extent that they became acceptable to the panelist (**Table 2**). Cooking 'S' samples by autoclaving at 120°C for 1h reduced the cooking time to 12.5% of that required by simmering at 100°C for 8h to achieve the same texture (about 86 kg/100 g).

Table 3 shows that increasing the cooking temperature reduced the maximum shear force for both 'S' and 'H' samples. Cooking at 125°C for 2h caused greater reduction in the texture of 'H' samples than in 'S' samples.

Sensory analysis revealed that texture of cooked faba bean was acceptable up to a maximum shear force of 100 kg/100 g. However, aroma, color, and flavor of

Table 1. Physical properties of the faba bean samples[1].

Sample	Weight of 1000 seed (g)	Volume of 1000 seed (ml)	Size grading		Hydration coefficient (after 2h soaking)	Swelling coefficient (after 2h)	Seed coat (%)
			Below 8 mm	Above 8 mm			
Soft-to-cook							
1	639a	562a	35	64	134a	142a	14.0e
2	602b	500b	41	57	133b	142a	13.8e
3	596b	492bc	43	56	134a	143a	14.3d
Mean	612	518	39	59	134	142	14.0
Hard-to-cook							
4	570c	475d	43	55	127cd	137b	14.5c
5	564c	477cd	39	59	128c	137b	15.0a
6	602b	500b	30	68	126d	138b	14.8b
Mean	579	848	37	61	127	137	14.8

1. Values followed by the same letter (in each column) are not significantly different at $P < 0.01$.

Table 2. Effect of temperature and time of cooking on the hydration and texture of cooked faba bean (*Medammis*); each value is mean of 3 samples.

Cooking		Soft-to-cook samples				Hard-to-cook samples			
Temp. (°C)	Time (h)	Hydration coefficient	Texture[1] Maximum shear force (kg/100g)	Texture[1] % reduction[2]	Moisture content (%)	Hydration coefficient	Texture Maximum shear force (kg/100g)	Texture % reduction	Moisture content (%)
100	8	268	87.9			246	125.0		
	10	270	74.4	15.4	72.0	247	111.0	11.2	68.2
	12	270	62.9	28.5	72.1	247	100.4	19.7	68.3
110	2	256	95.4		68.8	243	139.7		64.5
	3	257	70.6	26.0	68.9	246	105.4	24.6	67.6
115	2	262	71.3		69.7	246	110.2		66.7
	3	263	53.0	25.7	71.4	247	84.3	23.6	68.5
120	1	248	85.2		65.6	230	131.7		63.2
	2	262	57.9	32.1	72.8	243	86.1	34.3	70.1
	3	263	51.2	39.1	72.9	244	76.1	42.0	70.8
125	1	256	69.8		66.9	242	112.4		64.8
	2	263	57.7	17.5	71.7	251	74.5	33.7	69.4

1. Texture was acceptable to panelists for all samples, except the hard-to-cook samples that were cooked at 100°C/8 or 10h, 110°C/2 or 3h, 115°C/2h, 120°C/1h, and 125°C/1h which were judged not acceptable.
2. As compared to the maximum shear force of the shortest cooking time at the same temperature.

Table 3. Percent reduction in texture (maximum shear force) of the cooked faba bean samples as affected by increase in the temperature of cooking for the same time.[1]

Cooking		Percent reduction in texture (maximum shear force, kg/100 g)					
Temp. (°C)	Time (h)	Soft-to-cook samples			Hard-to-cook samples		
		5°C	10°C	15°C	5°C	10°C	15°C
110	2						
115	2	25.3			21.1		
120	2	18.8	39.3		21.9	38.4	
125	2	0.4	19.1	39.6	13.5	32.4	46.7
110	3						
115	3	24.9			22.0		
120	3	3.4	27.5		9.7	27.8	

1. As compared to the maximum shear force at temperatures lower by 5, 10, and 15°C.

cooked samples that varied in texture from about 55 to 140 kg/100 g, were acceptable by the panelists.

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تأثير حرارة ومدة الطهو على اماهة وقوام الفول المطبوخ (المدمس)

ملخص

طهيت ست عينات من بذور الفول المحصودة حديثا ، ثلاث منها طرية على الطبخ (S) وثلاث قاسية (H) ، وذلك بغليها على حرارة 100 م° لمدة 8 و 10 و 12 ساعة ، أو بوضعها في محم autoclave على حرارة 110 و 115 و 120 و 125 م° لمدة 1 و 2 و 3 ساعات . وكانت الفروقات بين العينات ضمن كل مجموعة غير معنوية على الغالب . كما أن معامل الاماهة (HC) لبذور الفول المطبوخ من العينات الطرية S ، كان أعلى مما هو في العينات القاسية H . ومع ذلك فان HC والمحتوى الرطوبي لم يتأثرا كثيرا باختلاف حرارة ومدة الطهو ، باستثناء معاملة الطبخ على حرارة 120 م° لساعة واحدة ، لانها أعطت قيما أقل من المعاملات الأخرى . ومن ناحية ثانية تأثر القوام بشدة بحرارة ومدة الطهو ، وكان الفول الذى يتصف بقوة ضغط shear force عظمى تصل إلى 100 كغ / 100 غ مقبولا عند المستهلكين . وقد أصبح قوام العينات " H " مقبولا عند الطهو على حرارة 115 م° لمدة ثلاث ساعات ، أو على 120 م° لمدة ساعتين . أما طهو العينات " S " على حرارة 120 م° فقد قلل مدة الطبخ بنسبة 12.5 % من المدة اللازمة للطهو بالغلي (لساعة واحدة على 120 م° مقابل 8 ساعات على 100 م°) للحصول على نفس القوام (أى حوالي 86 كغ / 100 غ) .

Contributors' Style Guide

Policy
The aim of FABIS Newsletter is to publish quickly the results of recent research on faba beans. Articles should normally be brief, confined to a single subject, good quality, and of primary interest to research, extension, and production workers, and administrators and policy makers.

Style
Articles should have an abstract (maximum 250 words) and whenever possible the following sections:introduction, materials and methods, and results and discussion. Authors should refer to recent issues of FABIS for guidance on format. Articles will be edited to maintain uniform style but substantial editing will be referred to the author for his/her approval; occasionally, papers may be returned for revision.

Disclaimers
The views expressed and the results presented in the newsletter are those of the author(s) and not the responsibility of ICARDA. Similarly, the use of trade names does not constitute endorsement of or discrimination against any product by ICARDA.

Manuscript
Articles should be typed double-spaced on one side of the page only. The original and two other legible copies should be submitted. The contributor should include his name and initials, title, program or department, institute, postal address, and telex number if available. Figures should be drawn in India ink; send original artwork, not photocopies. Define in footnotes or legends any unusual abbreviations or symbols used in a figure or table. Good quality black and white photographs are acceptable for publication. Photographs and figures should preferably be 8.5 cm or 17.4 cm wide.

Units of measurement are to be in the metric system; e.g. t/ha, kg, g, m, km, ml (=milliliter), m^2.

The numbers one to nine should be written as words except in combination with units of measure; all other numbers should be written as numerals; e.g., nine plants, 10 leaves, 9 g, ninth, 10th, 0700 hr.

Examples of common expressions and abbreviations
3 g; 18 mm; 300 m^2; 4 Mar 1983; 27%; 50 five-day old plants; 1.6 million; 23 ug; 5°C; 1980/81 season; 1980-82 seasons; Fig.; No.; FAO;USA. Fertilizers: 1 kg N or P_2O_5 or K_2O/ha.
Mon, Tues, Wed, Thurs, Fri, Sat, Sun; Jan, Feb, Mar, Apr, May, June, July, Aug, Sept, Oct, Nov, Dec.
Versus = vs, least significant difference = LSD, standard error = SE +, coefficient(s) of variation = CV(s). Probability: Use asterisks to denote probability * = $P<0.05$; ** = $P<0.01$; *** = $P<0.001$.

Botanical: Include the authority name at the first mention of scientific names. Cultivar(s) = cv(s), variety = var(s), species = sp./spp., subspecies = subsp., subgenus = subg., forma = f., forma specialis = f. sp.

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Submission of articles
Contributions should be sent to FABIS, ICARDA, P.O. Box 5466, Aleppo, Syria.

NEWS

أخبار

Book Reviews

مطالعات في الكتب

Principles of Seed Pathology

By V.K. Agrarwas and J.B. Sinclair
Published by CRC Press, Florida, USA
ISBN 0-8493-5921-X
Price: 225.00 USD for the 2 volumes

This exhaustive 2-volume set is a valuable reference source for researchers and workers involved with seed health testing, seed production, and plant quarantine. Topics covered in this book are: the mechanism of seed infection and seed transmission, longevity of seed-borne pathogens, epidemiology of seed-borne diseases, techniques for detection of seed-borne pathogens, historical development of seed pathogen, and the significance of seed-borne diseases in world agriculture.

Molecular Biology and Crop Improvement: A Case Study of Wheat, Oilseed Rape, and Faba Beans

By R.B. Austin, R.B. Flavell, I.E. Henson and H.J.B. Lowe
Published by the Press Syndicate of the University of Cambridge, Cambridge, UK. 1986
ISBN 0521-32725-3
116 pp.

This book is the report of a study on opportunities for the application of molecular biology to crop improvement in the EEC, with particular reference to wheat, oilseed rape, and faba bean, carried out by the Plant Breeding Institute (PBI), Cambridge, United Kingdom, under contract to the Commission of the European Communities (Division for Genetics and Biotechnology).

The results of this report show that by using different techniques of molecular and cell biology, certain improvements could be achieved in faba bean crop: i) widening the gene pool available to breeders, through introducing variation from related species into faba beans; ii) improving yield stability and yield potential by improving the drought resistance through the introduction of alien variation; iii) improving the resistance to the fungal pathogens *Ascochyta* and Botrytis by introducing genes from other *Vicia* species; iv) developing F_1 hybrids, this could be achieved by molecular analysis of CMS in '447' cytoplasm; v) investigating the feasibility of increasing the protein content by increasing the number of copies of the storage protein genes and; vi) also increasing the methionine content by modifying the amino acids in the variable regions of the legumin and vicilin storage proteins and substituting methianine for histidine residues.

The book provides a very comprehensive coverage of the current understanding of biology of these three crops (wheat, oilseed rape, and faba bean) and is a basis for future improvement.

Winter Cereals and Food Legumes in Mountainous Areas

Edited by J.P. Srivastava, M.C. Saxena, S. Varma and M. Tahir
Published by ICARDA, Aleppo, Syria
317 pp.

This book is the proceedings of an International Symposium on Problems and Prospects of Winter Cereals and Food Legumes Production in the High-Elevation Areas of West Asia, Southeast Asia, and North Africa, organized by ICARDA and the turkish Ministry of Agriculture, Forestry, and Rural Affairs, and held in Ankara, Turkey, 6-10 July, 1987. The aim of the symposium was to obtain a clearer perspective of the problems of the mountainous areas and the opportunity for solving them.

The book is divided into five sections. Section 1 deals with the agroclimatic characterization of high-elevation areas of ICARDA region. Section 2 deals with the production systems in such areas. Section 3, depending on individual country reports, reviews the current status of production, constraints, and research infrastructure in the mountainous areas. Section 4 deals with research for improved adaptation of crop genotypes for high-elevation areas. Recommendations for future research are given in section 5.

Copies of the proceedings are available from STIP, ICARDA.

Forthcoming Events

أحداث مرتقبة

Conference on Faba bean Production and Improvement Research in China

The Chinese Academy of Agricultural Sciences (CAAS), in collaboration with Zhie-jiang Academy of Agricultural Sciences (ZAAS) and ICARDA, is organising a conference at Hangzou, Zhie-jiang in May 1989 to review the progress made in China in the production and crop improvement research on faba bean. The conference will come up with recommendations for areas of research that need to be given priority in future and would suggest ways for networking with national and international programs to hasten that program of research.

China is the largest producer of faba bean in the world.

Present Status and Future Prospects of Faba Bean Production and Improvement in the Mediterranean Countries A Regional Conference

The Centre International de Hautes Etudes Agronomiques Mediterraneennes (CIHEAM) in collaboration with ICARDA would organise a regional conference at Instituto Agronomico Mediterraneo de Zaragoza (IAMZ) in Spain in June 1989. Details on the Conference can be obtained from Dr. Miguel Valls, Director CIHEAM, IAMZ, Apartado 202, 50080, Zaragoza, Spain.

The International Symposium on Insect-Plant Relationships

This symposium will be held in Budapest, Hungary, 3-8 July 1989. Topics covered by the meeting will be grouped into the following specific fields:

1. Physiology: sensory, nutritional, developmental, detoxification of allelochemicals, plant physiology and insect attack, etc.
2. Behaviour: orientation to plant, vision, olfaction, feeding, oviposition, foraging, role of experience, etc.
3. Ecology: community ecology, plant-insect population dynamics, seed predation, induced defense, plant succession and phytophagous insect impacts, species/area relations, biogeography, modelling, pollination, etc.
4. Phytochemistry: allelochemicals and phytophagy, chemotaxonomy of plants and its bearing on phytophagy, etc.
5. Evolution: evolution of plants and phytophagous insects, speciation of phytophagous insects, population genetics and components of evolutionary change, coevolution, etc.
6. Aspects of application: biological control, plant resistance to insects, biotechnological approach to plant resistance, antifeedants, use of natural plant products for plant protection purposes, etc.

For each field a round table discussion will be held.

For more information, please write to:
Secretariat
Plant Protection Institute of the HAS,
Department of Zoology,
Budapest, Pf. 102
H-1525 HUNGARY

International Symposium on Production of Vegetables in the Tropics and Sub-Tropics

This symposium, organized by the Tropical Agriculture Research Center of Japan, is intended to be held 20-22 Sept 1989, in Tsu, Japan.

For more information please write to:
Dr. M. Mikaye
Secretary of the Organizing Committee,
Tropical Agriculture Research Center,
Ohwashi, Tsukuba, Ibaraki,
305 JAPAN

Third International Workshop on Seeds Recent Advances in Development and Germination

This workshop will be held in Williamsburg, Virginia, USA, 6-12 August, 1989. The workshop will immediately follow the joint ASPP/CSPP meeting in Toronto, Canada, scheduled for 1989. Topics covered by the meeting will include: seed transformation and gene expression, somatic embryogenesis, hormone levels and seed sensitivity, mutants for studying seed development, membranes and storage, preservation of recalcitrant seeds, cell biology of recalcitrant seeds, phytin biosynthesis, calcium fluxes and calmodulin, protein targeting in development and germination, biochemistry of Anoxia, biochemistry of dormancy breaking, phytochrome and germination, impermeable seed coverings, stimulants of parasitic plant seeds, cyclical events in germination, germination stimulants in red rice, osmotic pre-conditioning.

For further information please write to:
R.B. Taylorson,
USDA, ARS,
Weed Sciences Laboratory
Rm. 38, Bldg. 001, BARC-West,
Beltsville, MD 20705, USA

International Conference on Seed Science and Technology

The conference organized by the Chinese Society of Plant Physiologists, the International Board of Plant Genetic Resources (IBPGR), and Zhejiang Association for Science and Technology (ZAST), will be held in Hangzhou, China, 7-11 November 1989. The conference will have two parallel programs: a scientific program and an exhibition of seed samples and of seed technology. The preliminary list of the major topics is: biochemical and mollecular aspects of seed formation, developmental regulation of gene expression, seed dormancy, germination and hormonal regulation, artificial seeds and somatic embryogenesis, seed vigor, testing and identification, germplasm preservation and utilization, instruments and equipment for seed research. There will be invited speakers and contributed poster/ oral presentations.

For further information please write to:
Mr Luo Xisheng
Zhejiang Association for Science and Technology,
47 Huan Cheng Rd. (North) 310003
Hangzhou, P.R. China

Second International Symposium on Adjuvants for Agrichemicals

The symposium will be held in Virginia Polytechnic Institute, Blacksburg, USA, 1-3 August 1989.

For details see FABIS-19.

Third International Conference on Food Science and Technology Information

The conference will be held in Budapest, Hungary 3-5 October 1989.

For your detailed information please check FABIS-19.

Plant Breeding International Cambridge Ltd.

Following the note in FABIS-19, page 29 on the transfer of BPI to Unilever PLc with temporary name NSDO, it is now possible to announce that the permanent name and address of this company is:

Plant Breeding International Cambridge Ltd.,
Maris Lane, Trumpington,
Cambridge CB2 2LQ,
United Kingdom

Need More Information ?

للمزيد من المعلومات

Need More Information on ICARDA Publications and Services ?

Free Catalog of ICARDA Publications
Request your list of all currently available publications from the Scientific and Technical Information Program (STIP).

ICARDA Information Brochure
ICARDA's historical background and research objectives are outlined in English and Arabic. For your copy, contact STIP.

LENS (Lentil Newsletter)
This newsletter is produced twice a year at ICARDA. Short research articles are published and comprehensive reviews are invited regularly on specific areas of lentil research. The newsletter also includes book reviews, key abstracts on lentils, and recent lentil references. For further information write LENS.

RACHIS (Barley, and Wheat Newsletter)
This ICARDA service is aimed at cereals researchers in the Near East and North Africa region and Mediterranean-type environments. It publishes up-to-the-minute short scientific papers on the latest research results and news items. RACHIS seeks to contribute to improved barley and durum wheat, production in the region; to report results, achievements, and new ideas; and to discuss research problems. For further information, write RACHIS.

Field Guide to Major Insect Pests of Faba Bean in the Nile Valley (English and Arabic)
This pocket field guide for research and extension workers explains how to identify and control the main insect pests of faba bean in Egypt and Sudan. The distribution, description, and biological characteristics are given for each insect, along with the type of injury, assessment of damage, and recommended control measures. A key to injuries is included. Insects and the damage they cause on faba beans are illustrated with 41 color photos. For your copy, write FLIP.

Field Manual of Common Faba Bean Diseases in the Nile Valley (English and Arabic)
This pocket field manual is a tool for field workers to diagnose and control diseases of faba beans in Egypt and Sudan. Symptoms, development, and control of various diseases are discussed, and symptoms are illustrated with 38 color photos. Also included are rating scales for disease resistance in faba bean lines and a glossary of basic phyto-pathological terms. For your copy, write FLIP.

Field Guide to Major Insect Pests of Wheat and Barley (Arabic)
This field guide in Arabic covers fungal, bacterial, viral, and physiological diseases, as well as insects and nematodes, that attack wheat and barley crops in the Middle East and North Africa. Forty-four insects and diseases are discussed and illustrated with 72 color photos. For your copy, write Cereals Improvement Program.

Introduction to Food Legume Physiology
This comprehensive 105-page technical manual is designed for food legume scientists and their support staff. It covers several areas of food legume physiology in a practical way, with examples whenever possible. The book contains four chapters covering the following: plant structure and physiological functions; mineral nutrition; photoperiodism, vernalization, crop canopy and radiation, and growth analysis; and physiology and crop improvement. For your copy, write Training Coordination Unit.

ICARDA's Food Legume Improvement Program
In English and Arabic, the 24-page illustrated information brochure briefly describes research projects on lentil, faba bean, and chickpea treated either as single crops or as a group. For your copy, write FLIP.

Screening Chickpeas for Resistance to Ascochyta Blight A Slide-tape Audio-tutorial Module
This slide-tape audio-tutorial module is the first in the food legume training series. It is designed for the use of legume trainees during the training courses at ICARDA as well as for scientists and their support

staff in the various national programs. This module is also useful educational material for universities and training departments in national research systems. For your copy of this publication or package, write Training Coordination Unit.

Checklist of Journal Articles from ICARDA 1978 - 1987
This checklist, compiled to bring information to the attention of the scientific community, consists of references of articles by ICARDA research scientists submitted to refereed scientific journals as of 1978. Each reference includes within year of publication: author, primary title, volume number, issue number, pagination, language code of the article and/or summary when necessary, and AGRIS reference number. For your copy write STIP.

Opportunities for Field Research at ICARDA
This brochure is intended primarily to assist Master of Science candidates, who are enrolled at national universities within ICARDA region and selected for the Graduate Research Training Program. It explains to them the opportunity they have to conduct their thesis research work at ICARDA research sites under the supervision of distinguished international scientists. For your copy, write GRI Program, Training Coordination Unit.

Opportunities for Training and Post-Graduate Research at ICARDA
ICARDA has active training courses on the development and improvement of food legumes, cereals, and forages with ICARDA's research scientists, trained instructors, and proven programs. For a complete brochure of the training opportunities at ICARDA, write Training Coordination Unit.

TO OBTAIN PUBLICATIONS:
Address requests for publications to the specific department or service cited above, at: ICARDA, P.O. Box 5466, Aleppo, Syria.

DOCUMENT COLLECTION

With the financial support of the International Development Research Centre (IDRC), ICARDA is building up its document collection on faba bean. The collection will be used to supply needed documents to scientists in developing countries.

We would be grateful if readers who have any relevant documents would send them to:

FABIS
ICARDA, Box 5466
Aleppo, SYRIA

If you have any

* faba bean news
* announcements of meetings
* book reviews
* new research interests
* suggestions

Please send them to:

FABIS
ICARDA, Box 5466
Aleppo, SYRIA

اعلان الى العلماء والباحثين العرب الكرام

يسر المركز الدولي للبحوث الزراعية في المناطق الجافة (ايكاردا) ، اعلامكم بان مركز بحوث التنمية الدولية (IDRC) في أوتاوا بكندا ، قد وافق على تقديم دعم مالي لمشروع فابس FABIS مدته ثلاث سنوات اعتبارا من بداية عام 1987 ولغاية 1989 ، علما بان ادراج اللغة العربية ضمن النشرة الاخبارية للفول يشكل أحد أهم أهداف هذا المشروع .

وبمزيد من السرور تعلن اسرة تحرير " FABIS " للباحثين العرب العاملين في مجال تحسين محصول الفول أنها تصدر نشرتها العلمية باللغتين العربية والانكليزية . لذا فيرجى من الاخوة العلماء الراغبين في نشر بحوثهم باللغة العربية التفضل بارسالها الى العنوان التالي : نشرة " فابس " ، ايكاردا ــ قسم التوثيق ، ص.ب. 5466 حلب ــ سورية .

ملاحظة :

تتم كتابة البحث بلغة عربية واضحة ، وفق الترتيب التالي :
1) الملخص ويكتب باللغتين العربية والانكليزية .
2) المقدمة .
3) المواد والطرق .
4) النتائج .
5) المناقشة ويمكن دمجها مع النتائج وتصبح (نتائج البحث والمناقشة) .
6) المراجع .

ARE YOU MOVING ?

If you are moving, please let us know your new address as soon as possible.
Send it to:

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Box 5466
Aleppo, Syria

فابس

مشروع المعلومات المتخصصة عن الفول

فابس ، نشرة علمية 22 ، كانون الاول/ديسمبر 1988

المحتويات

ايكاردا والمجموعة الاستشارية للبحوث الزراعية الدولية

يتمثل الهدف العام للمركز الدولي للبحوث الزراعية في المناطق الجافة (ايكاردا) في زيادة الانتاجية الزراعية والموارد الغذائية المتاحة في المناطق الريفية والحضرية بهدف تحسين الوضع الاجتماعي والاقتصادي لشعوب البلدان النامية وخاصة في شمال أفريقيا وغرب آسيا . وتركز ايكاردا اهتماماتها بصورة رئيسية على المناطق التي تعتمد في زراعتها على الامطار الشتوية التي تتراوح من 200-600 مم سنويا . وعندما تستدعي الضرورة ستمتد دائرة بحوثها لتغطي مناطق بيئية مروية او ذات أمطار موسمية .

ويضطلع المركز بمسؤولية عالمية في تحسين الشعير والعدس والفول . وبمسؤولية اقليمية في تحسين القمح والحمص والنظم الزراعية والثروة الحيوانية والمراعي والمحاصيل العلفية . كما ويعتبر تدريب وتأهيل الباحثين الزراعيين في البلدان النامية . وتبادل نتائج البحوث معهم أحد أهم الانشطة التي تقوم بها ايكاردا .

وقد ساهمت المجموعة الاستشارية للبحوث الزراعية الدولية (CGIAR) بتأسيس ايكاردا في سورية عام 1977 كمركز للبحوث لا يتوخى الربح . أما المجموعة الاستشارية للبحوث الزراعية الدولية فهي هيئة غير رسمية من المتبرعين تضم حكومات ومنظمات ومؤسسات خاصة . وتدعم البحوث الزراعية في جميع انحاء العالم بهدف تحسين الانتاج الغذائي في البلدان النامية . وذلك من خلال شبكة مؤلفة من ثلاثة عشر مركزا دوليا للبحوث من بينها ايكاردا . وتغطي أعمال الشبكة بحوثا على أنظمة المحاصيل والثروة الحيوانية التي تسهم في تأمين ثلاثة ارباع الغذاء في البلدان النامية .

فابس

تصدر ايكاردا نشرة " فابس FABIS " العلمية ثلاث مرات في السنة بدعم مالي من مركز بحوث التنمية الدولية (IDRC) في اوتاوا بكندا . وهي نشرة علمية متخصصة بالفول . وتعتبر وسيلة اتصال لتبادل نتائج البحوث حول هذا النبات . وتضم النشرة بحوثا مختصرة تهدف الى ايصال المعلومات بسرعة . اضافة الى بعض المقالات العامة التي تدعو اليها أسرة التحرير بشكل منتظم وتتناول مجالات معينة من بحوث الفول . كما تضم النشرة بعض الاعلانات . وهذه النشرة تقدم المعلومات حول بحوث الفول دون مقابل من خلال قوائم الاستجواب والتصوير النسخي (الفوتوكوبي) وجمع الوثائق العلمية المتعلقة بالفول .

الاشتراكات

توزع نشرة " فابس " العلمية دون مقابل للباحثين المعنيين بنبات الفول . وللاشتراك فيها يرجى الكتابة الى :

FABIS/Documentation Unit/ICARDA, P.O.Box 5466
Aleppo, Syria

صورة الغلاف : مدخل وراثي من الفول أزهاره بيضاء في محطة تل حديا بحلب ، سورية .

فابِس

نشـرة علميـة متخصصة بالفول

العدد 22 كانون الاول / ديسمبر 1988

المركز الدولي للبحوث الزراعية في المناطق الجافة
ايكاردا
ص . ب . 5466 ، حلب ، سورية